Chemical & Process Engineering

Chemical Plant Exhibition Issue

Vol. 34, No. 8 AUGUST 1953

CONTENTS

***Subscription rates:** I year 6 dollars, 3 years 15 dollars, paid in advance*

England: Leonard Hill Limited, Stratford House, 9 Eden Street, London, N.W.1 *U.S.A.: British Publications Inc., 30, East 60th St., New York, 22*

Topics of the Month

Petroleum chemicals and the oil industry

ALTHOUGH the oil companies were pioneers in the manufacture of petroleum chemicals, they have since lost their position as the biggest producers to chemical companies. Last year 7½ million tons of petroleum chemicals were produced in the U.S. and some 450,000 tons in Western Europe. Responsible for the gigantic output in North America were 143 companies, only 58 of which were petroleum companies or subsidiaries. Six were joint oil and chemical companies and the rest were straightforward chemical concerns. Of the total turnover of finished petroleum chemicals in the U.K. last year, only about 35% represented a direct return to the oil companies.

These facts were given by Mr. W. F. Mitchell, of the Shell Petroleum Co. Ltd., speaking last month at the oil industry luncheon in London. He was perturbed at the way in which the oil industry was losing ground to the chemical industry in a field which he regarded as a natural offshoot of oil refining, and the purpose of his talk was to diagnose the reasons for this failure and to suggest remedies. Delving into the origins of petroleum chemicals, he pointed out that only comparatively simple chemistry was necessary at first to produce such chemicals as acetone and methyl ethyl ketone from abundant and cheap reactive cracked gases. Again, only comparatively simple marketing methods were needed to sell the chemicals, because the demand for them already existed. But as the wider possibilities of oil as a chemical raw material were realised, both the chemistry and the marketing became much more complicated. The oil industry found itself facing a highly intricate market and for the most part it could not compete with the specialist chemical companies in satisfying it. These were the fundamental and readily understandable reasons for the chemical industry gradually taking the lead in the manufacture and marketing of petroleum chemicals.

Mr. Mitchell deprecates this seemingly logical trend and apparently wants the oil industry to enter more fully into the petroleum chemicals field. He warns, however, that it is necessary for oil companies 'to absorb the basic philosophy of the chemical industry and apply this to research, manufacturing and marketing and to realise at the outset that the petroleum chemicals industry, being closely related to the chemical industry as a whole, possesses both the opportunities and the restrictions of that great industry.'

It is natural that an oil man should want his industry to make more of the possibilities of upgrading a barrel of oil, particularly where this barrel of oil, in terms of fuel gas, has only small value in the normal market for petroleum

products. However, it would appear that the petroleum chemicals industry has become rather too complicated for an ordinary oil company to compete in it effectively. Only those oil companies who from the first have had the vision and the resources to create the necessary research and production facilities are now effective units in the petroleum chemicals industry. As a whole, the chemical industry proper now has the new industry too firmly in its hands for the present trend to be reversed.

Finnish agricultural chemicals

THE chemical industry in Finland has been able to alleviate the shortage of nitrogenous fertilisers in that country, caused by import difficulties, by starting up a nitrogen plant which is producing 14,000 tons p.a. of nitrogen, 35% of total requirements. This plant is owned jointly by two companies, Typpi Oy and Rikkihappo ja Superfosfaattitehtaat Oy. Another, much smaller, plant is producing 1,000 tons of nitrogen p.a.

The manufacture of almost all of Finland's needs of phosphate fertilisers is undertaken by the local chemical industry, which, however, imports the raw materials. The country's annual requirements are 85,000 tons of P_2O_5. Mixed fertilisers are produced at the rate of 100,000 tons p.a., but potassium fertilisers, about 40,000 tons of K_2O, are all imported.

Besides producing fertilisers, the Finnish industry is building up the manufacture of crop protection chemicals. Four firms are interested. They make some of their range in Finland and produce others from imported mixtures and concentrates. They also break down and pack imported bulk supplies of finished products. The annual retail sales value of crop protection chemicals and insecticides in Finland is between 400 and 450 million Finnmarks and this figure is increasing substantially each year.

Cheap substitute for filter cloth

KRAFT paper containing 5% neoprene latex as a binder is reported to have been tried successfully as a cheap substitute for filter cloth normally used for chemical slurries. The neoprene imparts wet strength to the paper; its dry tensile strength is 70 lb./in. of width and its wet strength in water about 30 lb. The minimum strength for safe use on an average filter press is 12 to 13 lb. It is claimed by the makers of the paper, the Du Pont Co., U.S.A., that it will withstand filtering or blowing pressures up to 25 p.s.i. and temperatures of 100°C. However, it is not immune to chemicals that attack cellulose or to strong oxidising solutions such as potassium permanganate or hot nitric acid.

Some cloth filters cost 15 times as much as the treated paper, so even if it could be used for only one filtration it would still have the edge over cloth in situations demanding frequent changes of filter. Where filter cloths can be used more than 15 times, the economy of the paper is not so apparent, especially as it has the disadvantage of reducing filtration rate, in some cases as much as 15%. However, the paper has the merit of easy removal from the press by slitting or peeling. Also it does not require cleaning. Perhaps the best way to use it is over or under one layer of filter cloth as a substitute for one layer of double cloth filter. This would protect the cloth and make it last longer. Conversely, the paper would be protected from the one hazard connected with its use, its tendency to tear because of scale in the slurry or corrosion of the filter press frame, or from sticking to the press.

Dead Sea chemicals again

PRODUCTION of chemicals from the mineral wealth of the Dead Sea, which was carried on for 20 years by Palestine Potash Ltd. until the war in Israel in 1948, is to be resumed this summer by a new company, Dead Sea Works Ltd. This is an Israeli corporation set up in June last year to acquire the assets of Palestine Potash. Fifty-one per cent. of the voting rights in the new company are held by the State of Israel.

The considerable experience of Palestine Potash is available to the new company, as are most of the original technical staff.

Dead Sea Works will base its operations on the potash works at Sodom, at the southern end of the Dead Sea. Only slightly damaged during the war, the plant is being renovated and new machine shops, loading facilities and warehouses are being installed. After overhaul, the plant will have an annual capacity of 60,000 tons of 96% pure potassium chloride, the primary product, which is used mainly for the manufacture of mixed fertilisers.

The Israel Government has allocated \$500,000 from the U.S. Export-Import Bank loan funds to Dead Sea Works Ltd. This is being used to buy new equipment to increase the plant's capacity. The following schedule has been set for the production of 96% pure potassium chloride: 1953-54, 60,000 tons; 1954-55, 100,000 to 130,000 tons; 1955-56, 150,000 to 180,000 tons.

When production is resumed the existing stock of carnalite, the raw material of potassium chloride, will also be processed. This stock has remained in the evaporation basins since production was interrupted in 1948. It is expected to yield 70,000 tons of potassium chloride.

The company will also produce magnesium chloride, ethylene dibromide and high-purity bromine. All three chemicals were previously made by Palestine Potash.

The company's products are mainly destined for export. The prevailing price for potash is about \$35/ton f.o.b. Haifa. Despite the current extremely high cost of transportation from the works at Sodom to Haifa, Dead Sea Works hope to be able to produce potash well below this price.

The Israel Government has given assurances that the company shall receive premiums on its exports to enable it to earn a minimum of 6% each year, provided that the company produces and exports not less than 50,000 tons of potash during the given year. The shareholders are thus assured of a dividend even in the first year of production.

Saving scarce materials

SULPHUR, cellulose, ores, plastics, iron and steel, and non-ferrous metals figure prominently in the programmes of research on raw materials conservation now being undertaken by organisations in Great Britain and the principal Continental countries. Typical of the work being done is that on sulphur; this includes studies of low-grade sources, acid production, conservation of acid, the biological production of sulphur and its recovery from furnace gases. The chemistry of cellulose is being studied, as is also its manufacture from wood waste. In the case of ores, besides studies on means of using low-grade ores, work is being done on ion exchange methods of extraction and the chlorination of ores. A big programme is devoted to fuels including the use of natural gas, methane, shale oils, etc., the gasification of solid fuels and coke conservation. The non-ferrous metals programme embraces the conservation of copper, zinc, tin, lead, tungsten, etc., the substitution of

aluminium for copper, the recovery of lead and manganese from scrap and the production of high-purity metals and pigments.

Protective coatings for metals are also being considered and this work no doubt impinges upon the corrosion studies, which are also part of the overall programme.

This note can give only very brief details of the scope of European research on the conservation of raw materials, but a complete list of researches has now been compiled by a sub-committee set up by the Organisation for European Economic Co-operation. The list consists of standard sheets each devoted to a particular subject of research and giving the names and addresses of persons or organisations from which detailed information can be obtained. These sheets can be seen at, or borrowed from, the Technical Information and Documents Unit of the D.S.I.R., Cunard House, 15 Regent Street, London, S.W.1.

Freedom for the fertiliser industry

AFTER 14 years, fertilisers in the U.K. were freed from price control on July 1. The general effect has been one of price easement save in the case of sulphate of ammonia, which has risen by 7s. 6d./ton, due largely, it is believed, to increased coal prices. Superphosphate is 8d./ton cheaper and potash about 10s. cheaper. Compound fertilisers have fallen in price by 10s. to 15s./ton, the actual reductions depending upon analysis. Most manufacturers have altered the early delivery rebate system for compound fertilisers and the largest rebates will be offered in November and December, not in July and August as formerly. In recent years these two winter months have proved to be the most difficult for moving goods out of over-stocked factories, and it is hoped that pressure upon storage space within the industry will be relieved more effectively. Much depends upon influences that are outside the industry's control. Certainly in July and August farmers have been reluctant to mortgage their own barn space with the harvest about to be gathered. It remains to be seen whether they will have sold their grain by November or December—if not, there will still be little room on the bigger farms for advance-purchased fertilisers.

It is a healthy sign that the industry as a whole welcomes its new freedom. Few other important chemical markets have been controlled for so long. Manufacturers believe that cost reductions can be passed on to consumers more rapidly in the absence of statutory price orders. Farmers may well feel that this argument cuts both ways, but at present some of the influential factors in production costs are tending to fall, *e.g.* freight charges for imported raw materials and costs of bagging materials. However, favourable influences such as these can be quickly offset if other costs such as labour, fuel and rail rates continue to rise. Most manufacturers have issued price lists only for the first four months of the 1953-54 farming year. Probably the most crucial factor is one that remains in the hands of the Government—the extent to which farmers' purchases of nitrogenous and phosphatic fertilisers will continue to be subsidised. During the brief period of de-subsidy two years ago, tonnage fell severely. Nothing affects production costs per ton more significantly than throughput. Fixed plant costs today are high and when plants work below capacity the incidence of these costs per ton rises sharply. Moreover, the trade becomes more seasonal if total demand drops and costs of distribution are also increased. These are more permanent factors of price control than legislation.

Chemical engineering and fuel technology

TO obtain basic chemical engineering data on the Fischer-Tropsch process for synthesising oils and chemicals from carbon monoxide and hydrogen made from coal and coke, the Fuel Research Station at Greenwich, London, has designed and built a pilot plant for producing 30 to 50 gal./day of oil. Experiments with this plant have been started in which the catalyst is kept moving as a fluidised solid by the flow of the reacting gases. Provision has also been made for pilot-plant experiments in which the reacting gases are passed through a suspension of the catalyst in oil. This work has led to improvements in the catalysts used for the process, and to advances in knowledge of the mechanism of the chemical reactions involved.

Further details of these experiments are given in the Fuel Research Station's annual report, *Fuel Research*, 1952, published recently by the Stationery Office (2s. 6d. net). The report also describes work designed to conserve coal supplies, particularly the best coking coals which now comprise only 6% of the total national coal reserves. To prevent rapid depletion of these reserves, an extension of the range of coals which can be blended to produce metallurgical coke is required. Experiments on a scale of carbonisation of several tons a day have shown that satisfactory metallurgical coke, as judged by the usual tests, can be made from blends of a first-grade Durham coking coal with as much as 50% of a weakly caking Northumberland coal. Experiments have also been made on the blending of gas-making coals with weakly caking coal for the production of domestic coke. The application of the results should assist in easing the difficulties of the supply of coal for making not only metallurgical coke but also coke suitable for domestic heating.

With increased mechanisation in coal mining, there is an inevitable increase in the proportion of coal of small size and higher ash content. Attention is being given, therefore, to the utilisation of these low-grade coals, particularly for the production of fuel gases. In preliminary trials with an experimental 'cyclone' generator, recently designed and constructed, in which the ash is removed as a molten slag, combustible gas has been produced from coal below $\frac{1}{16}$ in. in size, when gasified at high temperatures with air enriched with oxygen. The generator is now being adapted for similar trials with coke breeze, using air without the addition of oxygen.

At the request of the Admiralty, work on furnace fuel oils containing a high concentration of wax has been undertaken. Such oils tend to 'set' or 'gel' when cooled, thus causing difficulty in handling or pumping. Results so far obtained indicate that the changes in fluidity of a particular oil are affected more by the size of the crystals of wax that form in the oil than by the amount that crystallises; fluidity improves with increase in crystal size.

Experimental work on the design and operation of combustion chambers to enable coal and peat to be used as the source of energy for gas turbines has been continued. The 'straight-through' combustion chamber developed at the Fuel Research Station has been successfully operated for the combustion at atmospheric pressure of about 500 lb./hr. of coal. This chamber includes the F.R.S. 'grid' or 'multijet' burners, which are now in use in industry for burning pulverised coal in boilers and furnaces. The straight-through combustion chamber is now being developed to operate at a pressure of several atmospheres, so that it can be tested in conjunction with a turbine at the

National Gas Turbine Establishment of the Ministry of Supply.

The nation-wide survey of atmospheric pollution that is being carried out in collaboration with local authorities and others is steadily increasing in extent as more instruments for measuring the pollution come into use. Measurements made in London during the foggy weather of December 1952 are proving of value to the medical authorities who are investigating the effect of atmospheric pollution on health.

In addition to these items the report gives details of the work in hand on boiler availability and other industrial boiler problems, including the removal of sulphur compounds from flue gas, and also of the researches into the fundamentals of the chemistry and physics on which the various large-scale investigations are based, for example, coal constitution, surface chemistry, the use of radioactive tracers in a study of the Fischer-Tropsch synthesis and so on.

Fifty years of fused silica

IN 1903, at Wallsend-on-Tyne, the development of the first commercial method of fusing silica in the electric furnace created an industry providing small silica ware for chemical laboratories and large silica equipment for our industry. Before that foundation stone was laid there had been much experimental work in the United Kingdom and abroad. Seventy-five years ago Gautier used the blowpipe to prepare fused quartz tubes. Later, Sir Charles Parsons described his process for fusing silica by use of electrical heating with a carbon resistance rod in papers read to the Royal Society. Sir Richard Threlfall also described a method in which small insulators were prepared; yet in his 100-kw. furnace built at Oldbury he fused silica but did not form it. Thus it was not until 1903 that the British industry was born, the same year, incidentally, that Heraeus of Hanau began the German industry when he used an iridium tube-furnace for heating silica in the oxy-hydrogen flame.

In this British venture the furnace was a trough of sand with an internal heating-core of graphite, the carbon monoxide and any other gases evolved serving to blow out the fused silica to a large egg-shaped mass suitable for further treatment. The further reaction of silica with carbon was avoided, since these gases kept the fused mass from the heating core. Large tubular or sausage-shaped fusions were thus obtained for working or moulding, the fused silica formed having a grain due to laminations formed by the drawing-out of spherical bubbles usually formed in all previous silica products. Until the advent of this grain type of silica the product had been a white translucent silica, owing to the dissemination of gas bubbles, a type produced in particular by Elihu Thomson in the United States in a technique similar to that of Parsons and to that of Hutton, of Manchester, who had worked with Moissan on arc furnaces. By 1910 the Wallsend efforts had given birth to British fused silica ware or *Vitreosil*. It was shown at the Brussels Exhibition in that year, a heat-resisting material which demonstrated its superior qualities in the disastrous fire which destroyed the British section of the exhibition. In 1917 Wallsend became even more firmly the home of fused silica when the Silica Syndicate developed by Johnson & Matthey (from a process demonstrated by Shenstone at the Royal Institution), joined forces with the Thermal Syndicate. This link, strangely enough, was rather suggested in the effects of the Brussels fire, for only fused silica ware and Johnson & Matthey's platinum apparatus survived the blaze.

Chemical engineering conference

THE Institution of Chemical Engineers and the Chemical Engineering Group of the Society of Chemical Industry have taken the opportunity offered by the Chemical Plant Exhibition to be held next month, to stage a Chemical Engineering Conference at Olympia, London. The Exhibition, which is the subject of the special preview in this issue of CHEMICAL & PROCESS ENGINEERING, will run from September 3 to 17 and the conference will be held on five days beginning on September 7. It will be open to all who attend the Exhibition and no prior registration will be required.

The papers to be presented will cover a wide range of chemical engineering and related subjects. Here is the programme:

Monday, September 7

2.30 p.m. 'Carbon and Graphite as Materials of Construction for Chemical Plant,' by A. W. Morrison, B. W. Freedman and P. G. R. Haines (Powell Duffryn Carbon Products Ltd.).

4.00 p.m. 'Tantalum and Zirconium—Production and Properties,' by Dr. G. L. Miller (Murex Ltd.).

Tuesday, September 8

2.30 p.m. 'Developments in the Production of Chlorine with Special Reference to Mercury Cells,' by L. R. Thomas (Monsanto Chemicals Ltd.).

3.45 p.m. 'Recent Advances in Milk-Processing Plant,' by J. E. F. Renton (George Scott & Son (London) Ltd.).

Wednesday, September 9

3.00 p.m. A discussion on British chemical engineering in the light of recently published reports, to be opened by Sir Harold Hartley and J. Grange Moore. The reports in question will be the O.E.E.C. report on 'Chemical Apparatus in the U.S.A.' and the Anglo-American Council on Productivity report on 'Heavy Chemicals.' J. Grange Moore was leader of the A.A.C.P. team which produced the latter report.

Thursday, September 10

2.30 p.m. 'Recent Developments in Evaporation with Particular Reference to Heat-Sensitive Liquids,' by B. N. Reavell (Kestner Evaporator & Engineering Co. Ltd.).

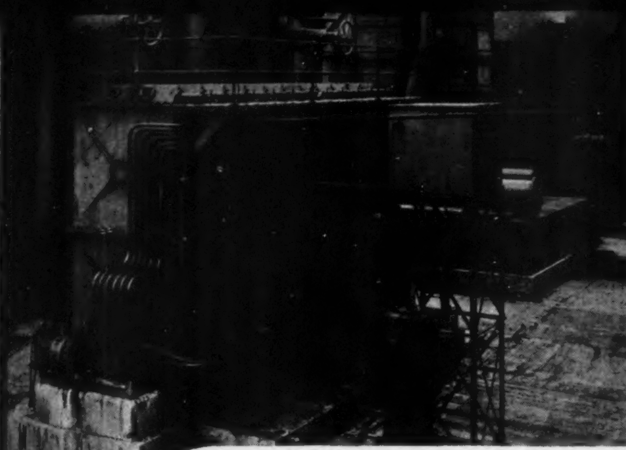
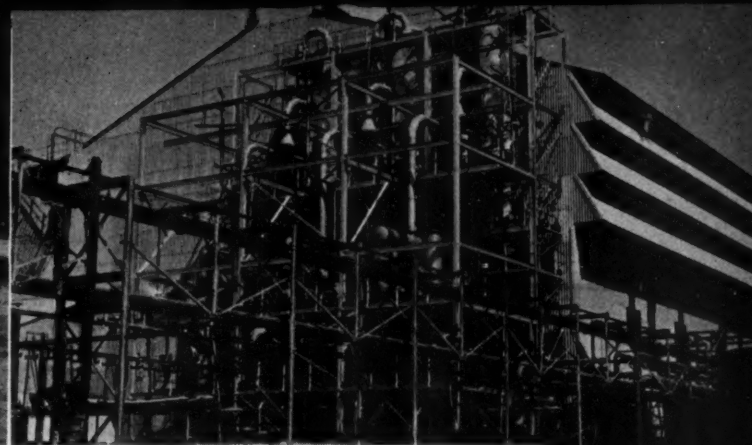
4.00 p.m. 'Recent Advances in Distillation,' by G. A. Dummett and Dr. P. V. Clifton (The A.P.V. Co. Ltd.).

Friday, September 11

2.30 p.m. 'The Production of Formaldehyde from Methanol by the Silver Catalyst Process,' by K. Nickels (Burnett & Rolfe Ltd.).

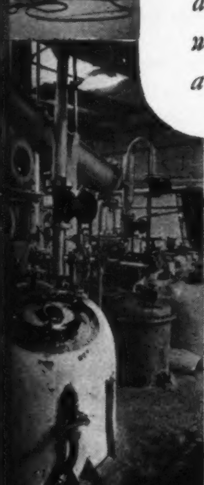
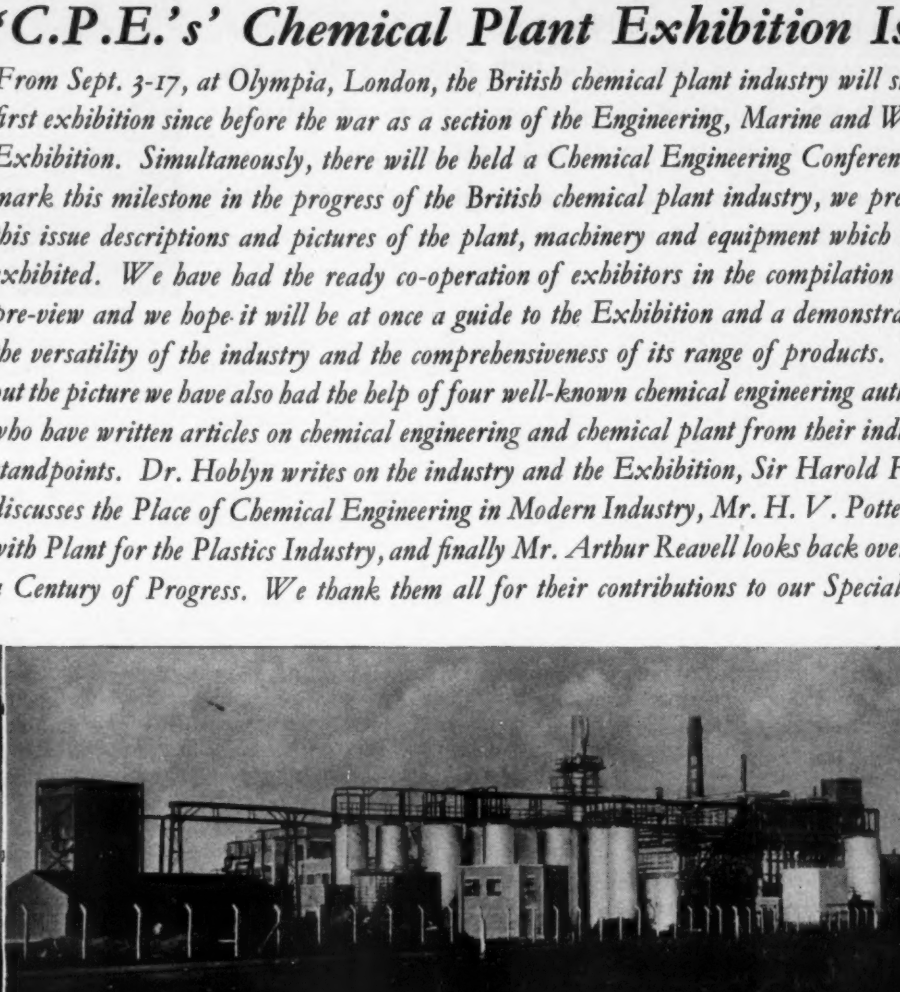
3.30 p.m. 'Recent Developments in the Application of Plastics to Chemical Plant,' by Verney Evans (Prodorite Ltd.).

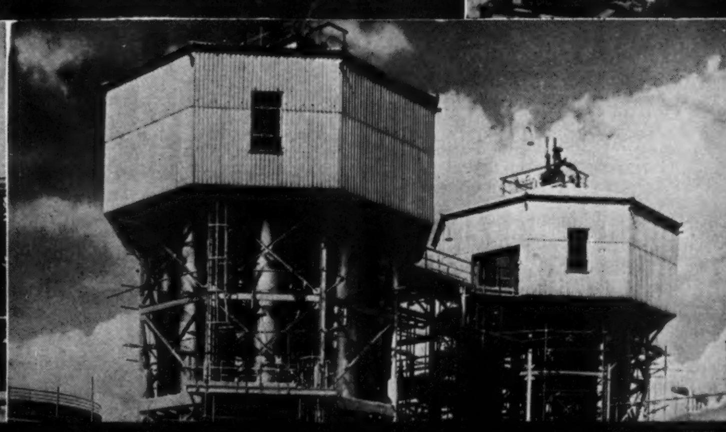
Visitors to the Exhibition can obtain information about the conference at the B.C.P.M.A. stand, No. 13, Row F, Grand Hall, Ground Floor.


'C.P.E.'s' Chemical Plant Exhibition Issue

From Sept. 3-17, at Olympia, London, the British chemical plant industry will stage its first exhibition since before the war as a section of the Engineering, Marine and Welding Exhibition. Simultaneously, there will be held a Chemical Engineering Conference. To mark this milestone in the progress of the British chemical plant industry, we present in this issue descriptions and pictures of the plant, machinery and equipment which will be exhibited. We have had the ready co-operation of exhibitors in the compilation of this pre-view and we hope it will be at once a guide to the Exhibition and a demonstration of the versatility of the industry and the comprehensiveness of its range of products. To fill out the picture we have also had the help of four well-known chemical engineering authorities who have written articles on chemical engineering and chemical plant from their individual standpoints. Dr. Hoblyn writes on the industry and the Exhibition, Sir Harold Hartley discusses the Place of Chemical Engineering in Modern Industry, Mr. H. V. Potter deals with Plant for the Plastics Industry, and finally Mr. Arthur Reavell looks back over Half a Century of Progress. We thank them all for their contributions to our Special Issue.

The Industry and the Exhibition

By E. H. T. Hoblyn, M.B.E., Ph.D., A.R.C.S., F.R.I.C., M.I.Chem.E.

(Director, British Chemical Plant Manufacturers' Association)

To introduce CHEMICAL & PROCESS ENGINEERING'S Exhibition Preview Issue, here is a special article by the Director of the B.C.P.M.A. Dr. Hoblyn began his industrial experience of chemical engineering in 1933 as a graduate apprentice with the A.P.V. Co. Ltd. Later he joined B.X. Plastics Ltd., eventually becoming a chemical plant manager at their Manningtree works. He joined the B.C.P.M.A. as secretary in 1944 and, in 1950, following the death of the director, he was promoted to his present post. He travels extensively abroad in furthering the interests of the association's members. At home he is closely identified with chemical engineering affairs on a national scale and has contributed considerably to educational matters in the industry.

THE CHEMICAL PLANT EXHIBITION, to be held at Olympia, London, from September 3-17 in conjunction with the Engineering, Marine and Welding Exhibition, will be the first such exhibition staged by the British chemical plant industry since the war; it will take place in a wholly engineering atmosphere and will demonstrate the technical progress which the industry has made and the manner in which it has increased in stature during and since the war. An added interest to the exhibition will be provided by the Chemical Engineering Conference to be held each afternoon from September 7-11 at Olympia, at which papers will be presented describing some of the recent developments in various fields of British chemical engineering. This conference is being organised by the Institution of Chemical Engineers and the Chemical Engineering Group of the Society of Chemical Industry.

Two world wars have demonstrated the importance to the country of its chemical industry; World War 2 and the years which have followed it have seen far-reaching developments in the British chemical industry which have great significance in the nation's economy; overseas countries, also, have set out for economic and security reasons to develop their chemical industries so that they can be as self-sufficient as possible in strategic chemicals.

In Britain, developments in the chemical industry, notably in the fields of petroleum refining, petrochemicals, antibiotics, plastics and synthetic fibres, have made exacting demands upon the British chemical plant industry, which in meeting them has grown in every respect—in the size of its constituent firms, in their numbers and in their technical competence.

As well as catering for the needs of its home customers, the British chemical plant industry has made an important direct contribution to the country's exports and, in most countries of the world where chemicals are made, British plant is to be found.

This has been achieved in the face of serious difficulties; from the end of World War 2 up till now the industry has been uncertain of its supplies of raw materials and components and only eighteen months ago was faced with a grave shortage of stainless steel which seriously retarded its production programme. This position has now changed, raw material supplies are more assured than at any time since the end of the war and, as a result, the industry is in a position to offer much more attractive delivery dates than hitherto.

At this point it is useful to examine the structure of the British chemical plant industry, which can conveniently be divided into several sections. First there are the firms who design, supply and erect complete process plant, and others who in co-operation with their customers engineer large complete plants or sections of them. The second category contains those firms who supply plant for unit chemical engineering operations such as size reduction and separation, distillation, evaporation, filtration and drying. Thirdly there are the fabricators who produce plant in a wide range of materials of construction for services ranging from something quite simple to those involving the most searching conditions of temperature, pressure and corrosion. Finally, there are the firms who supply ancillary equipment such as pumps, valves, instruments and packings and jointings.

Firms in all the above categories will have stands at the chemical plant exhibition.

Developments in the chemical plant industry

The most significant developments in the British chemical plant industry during recent years have been the increasing size of project which its constituent firms are prepared to undertake, the quality of the plant fabrication and the size of units fabricated and, finally, the increase in the range of materials of construction from which chemical plant is built. These developments are now examined in greater detail.

It is important that the part which the British chemical plant industry can play in large chemical engineering pro-

jects should be clearly understood, because it is found that all too often the competence of the industry in this direction is not fully appreciated.

The Government of India's 350,000-tons-p.a. sulphate of ammonia factory at Sindri; the petrochemical installations at Partington; superphosphate plant in Egypt; the *Autofining* plant at Llandarcy; continuous tar acid distillation plant; sulphur recovery plant for petroleum refineries; and solvent extraction plant for vegetable oils are but a few examples of how British plant manufacturers will engineer complete chemical factories or plants at home or overseas with buildings and services, working from their own flow sheets and designs, from clients' flow sheets or on the basis of processes developed with the client. For such projects the individual items of plant are made in the firms' own works or bought from specialist suppliers, while in the case of overseas projects use is often made of competent local fabricators. The work carried out on large chemical or petroleum installations includes all civil, mechanical and electrical engineering and instrumentation; it involves site erection of plant and often the site fabrication of pressure vessels and of pipelines to the exacting standards of the A.P.I./A.S.M.E. Code or of Lloyds for Class I welding, with radiographic testing on the site.

Post-war developments in the chemical industry and in particular those concerned with petrochemicals have demanded the production of units of plant of a size hitherto not made in the United Kingdom. The 130-ft. long distillation columns, the storage spheres for compressed gases and the various large process vessels which have so changed the landscape of Grangemouth, Shellhaven, Fawley and the Isle of Grain pay fitting tribute to the manner in which the inherent skill of the British craftsman has enabled him to meet these demands.

The key to the development on the industrial scale of many chemical processes is the availability for plant construction of materials which are resistant to the chemicals in use under the conditions of temperature and pressure involved. The tendency today is for these working conditions to become increasingly searching. It is inevitable, therefore, that there should be continuous effort to develop new constructional materials, and British firms have not been backward in such development or in learning how to fabricate the new materials. In the metallic field one of the interesting developments is the introduction of tantalum and zirconium as materials of construction for chemical plant, while in the non-metallic field great progress has been made in the application of carbon, glass and plastics. Glass lends itself to the production of complicated equipment on an industrial scale and glass tubes are now available for column construction in diameters up to 18 in. Among developments in recent years in the plastics field are the applications of polyvinyl chloride and polyethylene, the latter material itself being a British discovery. Many forms of these materials are now available for plant lining or fabrication; an example of a recent development is the production of unplasticised PVC tubes up to 4-in. diameter on British extrusion machines.

In mentioning particularly some of the newer materials one must not lose sight of the host of well-tried metals and alloys and non-metallic materials which are available, and the Chemical Plant Exhibition will provide the visitor with numerous examples of the application of aluminium, copper, nickel and their alloys, stainless steel and the clad steels, and the noble metals in plant construction; similarly it will be possible to see examples of the use of ebonite and stoneware, together with linings of enamel, glass, lead and rubber. In all these fields there have been developments to meet changing demands.

The B.C.P.M.A.

The Chemical Plant Exhibition is sponsored by the British Chemical Plant Manufacturers' Association and all the firms in the exhibition are members of the Association; in addition, 24 members are exhibiting in the Engineering, Marine and Welding Exhibition.

The Association, whose membership comprises some 200 manufacturers of British chemical and allied plant, was formed in 1920. Its principal objects include the fostering of the manufacture of British chemical plant and its use at home and overseas, the promotion of close co-operation between British chemical plant manufacturers and the facilitation of the interchange of information.

B.C.P.M.A. maintains close contact with the Government, the Association of British Chemical Manufacturers and the Institution of Chemical Engineers and is affiliated to the Federation of British Industries and the British Engineers' Association. It is also represented on 28 specialist committees of the British Standards Institution and, in co-operation with the users of chemical plant, is endeavouring to promote the greatest possible degree of standardisation in a very complex section of the engineering industry.

Since the end of World War 2 officials of the Association have visited India, South America, South Africa, Scandinavia, Canada, the United States, France, Belgium, Germany and Spain to learn the requirements of the chemical plant industry's customers abroad and their future developments, to meet the local agents of member firms and to locate potential agents for members not already represented.

The Association publishes *British Chemical Plant*, a biennial directory of members, which is the authoritative guide to the British chemical plant industry. This directory, which is available free of charge to manufacturers in the chemical and allied industries, has a list of members with their addresses and those of their overseas agents; a comprehensive classified index of their products and services with keys in French, German and Spanish; and an illustrated section describing their manufactures.

It will be appreciated from the above that the B.C.P.M.A. is in an excellent position to help the chemical plant buyer. It does so in the following ways:

- Its staff includes qualified chemical engineers with whom he can discuss his requirements.
- It has a comprehensive collection of catalogues which he may consult.
- It gives him the names of appropriate manufacturers or circulates his enquiry among them.
- It gives him introductions to its members.
- If his enquiry is for plant outside the chemical engineering field, it puts him in touch with the appropriate trade association.
- If he is interested in United Kingdom facilities for the training of chemical engineers, it will gladly advise him.

The Association is not a selling or trading organisation and its advice is given free and without obligation.

The Association will have its own stand at the exhibition and it is hoped that visitors will make it one of their first points of call.

The Place of Chemical Engineering in Modern Industry

By Sir Harold Hartley, K.C.V.O., F.R.S.

(Immediate Past-President of the Institution of Chemical Engineers)

In this article the author deals with the theme of chemical engineering as the fourth primary technology, as one of the main driving forces in the development of new techniques, new processes and new industries. He ranges over a vast field, touching particularly on the contributions of the technology in the upgrading of raw materials, the food industry, the fermentation industry, metals and nuclear power. Sir Harold Hartley was Controller of Chemical Warfare from 1918-19, chairman of the Fuel Research Board from 1932-47, vice-president and research director of the L.M.S. Railway from 1930-45 and chairman of the British Overseas Airways Corporation from 1947-49. He is president of the World Power Conference and a past-president of the British Association.

THERE should be no need to stress the vital part that chemical engineering is playing in the evolution of modern industry, but I find that most laymen and even some engineers are still doubtful as to its exact province and as to how this fourth primary technology has come into being. The widespread uses of the plant to be shown in the Chemical Engineering Plant Exhibition at Olympia is an object lesson in what has been achieved in this country.

The recent report of the O.E.E.C. Mission to the United States gives an excellent survey of the rapid growth of chemical engineering in America and of the trends of technical development. But as I pointed out in a letter to the *Times*, the title is misleading. 'Chemical Apparatus in the U.S.A.' should be 'Chemical Engineering in the U.S.A.'

The basis of chemical engineering is the scientific study of the transfers of mass and energy which accompany the chemical and physical changes involved in many industrial processes. The application of the results of that study to the design, construction and operation of plant has resulted in the evolution of a new primary technology comparable with the older technologies of civil, mechanical and electrical engineering. This has been recognised in America by the courses in chemical engineering in the engineering faculties of practically every university and college, and there are welcome signs that at long last the need for similar courses in our universities is being recognised here. Any young man entering the engineering profession should have the opportunity to study this new branch, with its great possibilities, if he wishes to do so. Chemical engineering is not competitive with the older branches but complementary to them. In the design and construction of the huge modern chemical engineering plants, the civil, mechanical and electrical engineers must play a part, but the chemical engineer is responsible for process design and then for co-ordinating the contributions of his colleagues to equipment design and construction. The statistics given on p. 34 of the O.E.E.C. report show the wide range of industries in which chemical engineers are being employed in America. The reason is that so many industrial processes outside the chemical industry now make use of some of the modern chemical engineering techniques, *e.g.* for heat exchange, drying, mixing, separation and extraction, purification, instrumentation and temperature and pressure control. A few examples of this are given below.

The processing of raw materials

One of the most striking contributions of chemical engineering has been in the field of the scientific processing and upgrading of raw materials. Formerly these materials were generally used in a relatively crude state, there was much waste and many materials such as metals were extracted mainly from the richest sources. Today that picture is changing rapidly. Most raw materials are being processed, wastes of all kinds are being utilised and the low-grade ores, on which the world must rely so largely in the future, are being 'beneficiated' (why not upgraded?).

Oil is, of course, the most impressive example of this general trend. The concentration of research and development in the oil industry has led to a revolutionary upgrading of oil products, accompanied by great economies, and to the new chemical industries based on cracked gases. All this in turn has resulted in new methods and techniques which have had a far-reaching effect on the chemical engineering of other industries. The best example is the fluidised-bed technique, which was foreshadowed in the Winkler generator, but, like so many ideas from Europe, found its widespread application in the United States. With its great advantage of rapid heat interchange between solids and gases, of quick

contact between solid and gaseous molecules and of rapid temperature adjustment and control, it is finding application in many directions. For instance, it opens up new possibilities for the low-temperature carbonisation of coal, which may, by this means, produce large quantities of liquid hydrocarbons to help to cope with the world's increasing demands for oil. A plant is being built in Texas on this principle to provide fuel for a generating station of 300,000 kw. capacity. Lignite is dried in a fluidised bed and is then carbonised in a vertical stream of hot gas at a temperature of 900°F., yielding $\frac{1}{3}$ gal. of tar per ton of lignite and a char which is conveyed pneumatically direct to the boiler plant. Any non-caking coals could be carbonised in a similar way.

In catalytic processes also the fluidised bed is finding many uses and it is likely to play an important part in the upgrading and treatment of low-grade ores.

The processing of food

Food, next to peace, is the greatest need of the world today and in no other field are the applications of chemical engineering more conspicuous. Research into nutrition has given us scientific standards for the nutritional needs of men and animals, both in the all-important years of growth and in the maintenance of health and activity in later years. Those needs are gradually being met more efficiently by the processing and transport of natural products, animal and vegetable, aided by the production, partly by synthesis, of the vitamins which are so essential to bodily well-being. Much more food is needed, for at this moment probably three-quarters of the population of the earth are suffering from malnutrition.

With the varied climates and soils of the world, few countries are self-sufficient in producing all the constituents of a balanced diet. The techniques of chemical engineering are being applied to meet these needs in many ways. The delicate and vital constituents of foods are easily destroyed and one of the great problems is their transport without deterioration and their storage. In many cases this is achieved by maintaining controlled conditions of temperature, moisture and atmosphere, or by deep freezing or chilling. In others it is achieved by concentration, as with fruit juices, or by drying, as with milk or carotene in young grasses.

Then there is the extraction of essential constituents in the preparation of concentrated food products, easy to transport and store and some of them necessary in the treatment of certain diseases. The extraction of vitamins, in which molecular distillation has proved so valuable, is another example of the many ways in which chemical engineering is being applied. Its applications in the great industries of sugar refining and margarine production are obvious. Food will remain the great world problem and in its solution chemical engineering, or rather bio-chemical engineering, will be a decisive factor.

The fermentation industry

Next to agriculture, fermentation is probably the oldest industry in the world and now with our more intimate knowledge of the habits of bacteria and unicellular organisms it is being adapted to the production from vegetable materials of many of the organic substances we need today. New developments have depended largely on the accurate control of the environment of the bacterial activity and on the improved methods of separating homogeneous mixtures by hypersorption, centrifugal extraction and fractional and extractive distillation.

The large-scale production of antibiotics like penicillin, streptomycin and aureomycin has only been made possible by the adoption of chemical engineering techniques. The successful growth of the submerged cultures of moulds requires accurate control of temperature, concentrations of nutrients, oxygen concentration and *p*H, as well as the protection of the cultures against the attack of bacteriophages. Then the extraction and purification of the small concentrations of these delicate complex materials presented a series of difficult problems. Penicillin, after filtration of the mould, is extracted by butyl alcohol using centrifugal counter-current extractors. It is then crystallised under vacuum after the water has been removed from the butyl alcohol solution by azeotropic distillation. Streptomycin is extracted by adsorption on a carboxylic base exchange resin from which it is eluted by dilute acid. After neutralisation by passage through an anion exchange resin, the streptomycin is isolated in the form of a salt.

The metallurgical industries

In the extraction of metals from their ores, chemical engineering equipment plays an important part in the preliminary process of ore dressing by means of classifiers, thickeners and in flotation treatment. With the need in the future to rely more and more on lower-grade ores, their upgrading is a vital problem. Here chemical engineering has already shown its power in the profitable extraction of gold from ores containing not more than 1 dwt. per ton, and in the extraction of magnesium from sea water containing about one part of the metal in a thousand, made possible by the accurate control of chemical conditions in vast volumes of water and by the adaptation of existing techniques. Other examples are the production of titanium and the preparation of extremely pure zinc by fractional distillation. The extraction of uranium from tailings on the Rand is the latest success of chemical engineering in this field.

Nuclear power

The development of nuclear reactors has involved chemical engineering at each stage, starting with the extraction of the primary raw materials, uranium and thorium, from their ores and the separation of isotopes for the enrichment of the fissile material. The building of the reactors has called for new materials capable of operation at high temperatures under intense radiation with the maximum economy in neutrons. Then the safe transfer of heat to the generating plant requires coolants with special properties and involves new techniques. The processing of 'spent' irradiated materials to remove fission products and recover the fissile material presents an entirely novel set of problems and a completely new conception of remote control because of the dangers from radiation. Later comes the separation of fission products of value in industry and medicine and the disposal of unwanted residues. All this involves the development of fresh chemical engineering processes and the design and operation of new forms of plant.

Conclusion

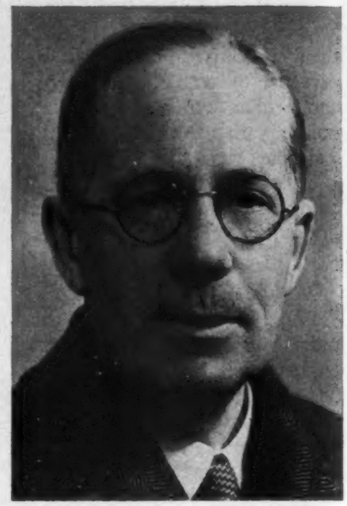
It would be easy to multiply instances of other industries into which chemical engineering has introduced scientific techniques—pulp and paper mills, cement, rubber, leather,

(*Concluded on page* 234)

Chemical Plant for the Plastics Industry

By H. V. Potter, B.Sc., F.R.I.C., M.I.Chem.E.
(*Chairman and Managing Director, Bakelite Ltd.*)

The vigorously growing plastics industry has provided many new opportunities for chemical engineering and plant manufacture. The exacting nature of the demands made is emphasised in this contribution from the head of one of the largest British plastics manufacturers. Mr. Potter's views are especially interesting in that, besides having played a notable part in the creation of the British plastics industry, he has simultaneously shown constant interest in the development of chemical engineering. His understanding of the problems of the chemical engineer and his desire to promote the development of the technology have been particularly evident in recent years during his chairmanship of the flourishing Chemical Engineering Group of the Society of Chemical Industry. In this article he asks for closer co-operation between plant manufacturers and plastics manufacturers in their mutual interests.



THE rapid expansion and development which is still taking place in this country in the production of synthetic chemicals, plastics and products of oil refining has placed a heavy demand on the resources of the chemical plant manufacturers.

The requirements call for higher pressures, special alloy steels, closer control, extremely high safety factors and special designs for dealing with toxic and other materials with special hazardous properties.

The design and construction which has had to be carried out in the post-war period has been subject to the handicaps of material shortage, government control and the lack of experienced designers and craftsmen and of special steels. These have now very largely been overcome and evidence of the successful efforts of the chemical plant manufacturers is to be found in the new chemical plants and oil refineries which have come into production of recent years.

Standards

Progress has been made in the preparation of standards covering methods of construction and special steels. Much development of these took place in the war years when the maintenance of many standards had to be allowed to lapse. In 1948 the Associated Offices Technical Committee of the leading British insurance companies issued a revision of their rules, first published in 1939, for the construction testing and scantlings of metal-arc welded steel boilers and other pressure vessels. This was followed by the issue in 1949 of a provisional British Standard Code, prepared under the supervision of the Chemical Engineering Industry Standards Committee, for fusion welded pressure vessels for use in the chemical and allied industries. The fact that this code is still provisional is a measure of the difficulties with which chemical plant manufacturers are faced.

In two of the approved British Standards of particular interest to the industry, *i.e.* B.S. 1501-1506: 1950 and B.S. 1507-1508: 1950 for steels and steel pipes and tubes for pressure vessels, reference is made respectively to comparable British and American specifications for steels, and in B.S. 1501-1506 a table comparison of British and American specifications is included. This example of correlating British and American practice is particularly welcome, as it is exceptional for British and American steels to correspond exactly in all respects. The greater availability of steel and the freedom from restrictions, coupled with the wider acceptance of standard construction by both suppliers and users of chemical plant, should enable the traditional high standard of British engineering design and craftsmanship to continue and improve its service to the new chemical and allied process industries.

Development of special machines

The rapid expansion and development which is still taking place in the plastics industry has to a large extent led to the design of new equipment or the use of plant and machines primarily designed for the earlier processes. Whilst it may be true that many of these machines may have been built to perform the same basic function in the earlier applications, modification of standard machines is the rule rather than the exception.

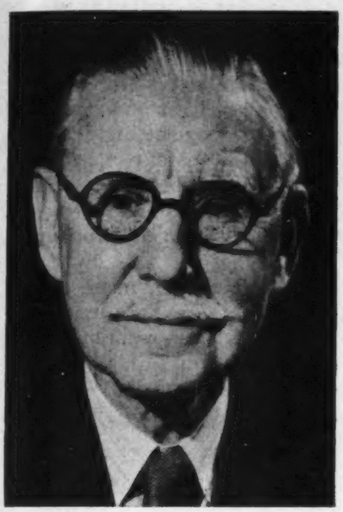
As an example, the nature of the materials which have to be processed in the manufacture of plastics calls generally for more arduous conditions of service and greater accuracy and closer control than in the industry for which the basic machine was developed. In the manufacture of synthetic resins and secondary products such as moulding materials and laminated sheeting, and in the compounding and processing of polyvinylchloride plastics, the basic machines have been developed mainly from those used in food and rubber processing. The designs for the adaptation of these older machines and for completely new machines has, to a large extent, been carried out within the plastics manufacturing industry in this country. It has not always been

(*Concluded on page* 234)

Half a Century of Progress

By J. Arthur Reavell, M.I.Mech.E., M.I.Chem.E., F.Inst.F.

(*Chairman, Kestner Evaporator & Engineering Co. Ltd.*)



It is only by looking back that the true measure of progress achieved in chemical engineering can be properly appreciated. To put modern accomplishments in perspective in this way, few men are better qualified than Mr. Reavell, who has had more than 50 years' intimate experience of British chemical engineering. Today, at the age of 80, he is still the active head of one of the foremost chemical engineering firms. He is number two on the list of original members of the Institution of Chemical Engineers, he founded the Chemical Engineering Group of the Society of Chemical Industry and he was one of the first chairmen of the British Chemical Plant Manufacturers' Association. Drawing upon his truly unique fund of knowledge, Mr. Reavell discusses progress in acid manufacture, instrumentation, heating methods and materials of construction.

IT is often said by the younger generation who are entering the industry after finishing their university course that life is much more difficult today than it was in the old days. The fact is that changes and advances in scientific knowledge have been so great that problems that were impossible to solve 50 or 60 years ago now present no difficulties at all.

Acid manufacture

Let us look for a minute at the position of the manufacture of sulphuric acid then and now. Then acid was manufactured by the chamber process, where the acid was circulated in the system by means of a hand-operated acid egg. Changes began when the acid egg was replaced by the pneumatic acid elevator which discharged regular quantities of acid automatically. The addition of mechanical draughting instead of chimney draught meant there was no longer the complaint that one heard—'This is a bad day for the plant'—which indicated that the draught was either non-existent or fluctuating considerably, resulting in lower output. Mechanically-operated fans eventually took the place of chimney draught, which not only increased the output but provided regular working and operating of the unit.

The first draughting fans were constructed of lead and driven by small steam or gas engines, not at that time by electric motors, whilst the air compressors were usually driven by steam engines through leather belts. Steam engines were used for many similar purposes, all single-cylinder exhausting to atmosphere and very inefficient, but coal was inexpensive. It was a far cry to the completely automatic operation of a catalytic system of acid manufacture, then only the dream of far-sighted enthusiasts.

No longer can the old processes of nitric and hydrochloric acid manufacture be seen—they have been replaced by synthesis. The manufacture of caustic soda was mostly by the Le Blanc process and hydrochloric acid was produced on the saltcake process. Those who saw the old black-ash revolving furnaces were looking on a very fine piece of chemical engineering and, when it is realised how scanty was the metallurgical knowledge and how limited were the instruments available, it can be seen how much know-how was demanded of manager and operator.

Instruments

In those days practically the only instruments available for the technicians were the thermometer, hydrometer and pressure or vacuum gauges. Now there is a galaxy of instruments for every available purpose.

Today the operator can sit in an instrument room and tell the height of liquor in any tank long distances from his centre of operation; he also has before him a complete record of temperatures, densities and all other essential figures so that from one centre he can now control the whole of the operations of an extensive plant.

The method of heating liquids and solids has become almost revolutionary. In the old days the only method of heating was by direct coal firing or steam coil; the use of gas was beginning and often abandoned because there were no methods of distribution and control. Now there are available many forms of heating. Steam coils and jackets that were operated at a relatively low pressure are now available for high pressures and temperatures. Where high temperatures are required today—temperatures that are far beyond the commercial use of steam—these are obtained by circulating oil or eutectic mixtures of one kind or another. In the case of oil the pressure is only a few pounds, whilst for the eutectic mixtures a relatively low pressure is required to obtain very high temperature.

Heating methods

There are also many forms of electric heating. Thus, in the case of liquids such as oil which is not an electrolyte, these can be heated by direct heating elements placed in the oil itself, and can be controlled thermostatically and operated to any given temperature by time switches.

We have also available such electric heating as infra-red, that is used very successfully to dry paint and varnishes. High-frequency heating is now generally used, particularly for sensitive products.

Thus, from the old system of the direct fire or the steam coil, there has come this wide variety of heating methods, all of which can be controlled thermostatically. It is probably true to say that in the heating methods more changes have occurred in the last 50 or 60 years than in any other chemical operation.

Constructional materials

If the foregoing were the only changes that have occurred they would be revolutionary enough, but what about the new metals and alloys that have been evolved? And not only the new metals themselves, but the new methods of working and shaping these new metals. Sixty years ago there was no tellurium lead, and lead burning as we know it today was also unknown. Stainless steel and aluminium were practically unknown, so was silicon iron, and nickel was then a rare metal. Now all these can be obtained in every conceivable shape, and are invaluable metals. The chromes were unknown—and so the story goes on, as years roll by some addition is made to the constructional materials available for the chemical engineer. If not such new metals as tantalum or zirconium, then at least some new alloy of the older metals.

One of the oldest constructional materials in the chemical industry is glass. Its manufacture and use has been practised for centuries, but in the last decade new developments in the technique of manufacture and utilisation of glass have made it a material that cannot be overlooked by the chemical engineer in the construction of modern chemical plant.

One of the most remarkable innovations has been the use of plastics as a constructional material by the chemical engineer, although, indeed, plastics is a term that is so easily misunderstood, at least by the general public. The increased production of various forms of synthetic resins, the utilisation of these resins with fillers that are resistant to so many chemicals—fillers such as asbestos, carbon and the like—all these have made possible processes that were not even dreamt of in the half century that has gone. Materials like PVC are so commonplace that they have graduated from the chemical field and became a material for the ordinary domestic plumber.

The story of the resin products is certainly not at an end, as here again completely new forms of these chemical substances are constantly being developed. It is not only in the production of new alloys and metals and synthetic substances like so-called plastics, but it is in the use and application of them that startling changes have taken place.

Welding

Who would have thought 50 years ago that welding would have become almost a commonplace. The old hand-bellows and furnace of the blacksmith—who, let us acknowledge, was a wonderful craftsman—are now being taken over by the welder with his electric apparatus and the various combinations of gases such as oxygen, coal gas, acetylene, etc.

Thus, it is not in the development of the materials alone but in the development of the means of using them also that a revolution has come about. These new materials of construction and new methods of fabrication have made possible the development of chemical processes that could not have been thought of 50 or 60 years ago.

The Place of Chemical Engineering in Modern Industry

(*Concluded from page* 231)

synthetic textiles, glass and ceramics, the carbonising industry, water treatment, the boiler house and laundries. The Chemical Engineering Plant Exhibition at Olympia shows the wide applications which the plant is finding in almost every industry.

The three great changes that have marked the evolution of modern industry are mechanised production, the scientific processing of raw materials and the development of synthetic products. In the last two chemical engineering has been the essential instrument. The counterpart to mechanised production in chemical engineering has been the replacement of the older batch methods by continuous processes with instrumental control which give larger throughputs and yields, better quality and savings in man-power. In these three ways chemical engineering has made a vital contribution both towards the better use of the world's natural resources and the development of new industries to meet the varied needs of modern life.

Chemical Plant for the Plastics Industry

(*Concluded from page* 232)

easy to get manufacturers to carry out these modifications or to construct special machines and it is sometimes necessary for the prototypes of the latter to be constructed in the user's own engineering workshops.

There is evidence that engineering concerns are turning their attention to the production of plant for the plastics materials industry and are including these in their range of standard products. The requirements of the industry are becoming better understood and it is to be hoped that the skill and design facilities available in the factories of our plant manufacturers will be increasingly applied to the requirements of the plastics industry. In this respect the industry in this country does not appear to be so well served as its counterpart in the United States. The availability of standardised equipment in America for the chemical industry is commented on in the report of the team of the Anglo-American Productivity Council on the heavy chemical industry. There is room for closer co-operation between the chemical and plant manufacturers, also for great willingness to compromise on the part of the user in his demands for special non-standard machines and on the part of the supplier in producing a standard machine which will meet the general requirements of the industry.

While the plastics industry is still expanding and newer materials are being developed, the demand for special-purpose machines will continue. In the older branches such as phenolic and other thermosetting resins, techniques have tended to become stabilised and there is now available more or less standard equipment for the production of resins, moulding powder and laminated materials. In the newer branches, techniques are still in the process of development and it is practically impossible for the plant manufacturer to keep up with these; he is being called upon to produce machines to the utmost practicable limits of accuracy. The high cost and difficulty of obtaining such machines quickly is being met by research directed to modifications of formulae and processes. It is in this field that the chemical engineer can make a valuable contribution to the economy not only of the plastics industry but of this country.

Exhibition Pre-View

Large-Scale Plant

Most items of plant in this category are too large to be exhibited and they will be represented by models, photographs and diagrams

The A.P.V. Co. Ltd. will have a stand designed to bring out the four aspects of the service which they offer, namely complete processes, unit plants, process engineering and fabrication and castings.

Particular attention will be given to the A.P.V.-West **distillation plate,** for which very high efficiencies and vapour velocities are claimed. Various models will illustrate different sizes and metals. A 30-ft. tower will be exhibited which will contain 45 of these plates when complete—it forms half a unit in a tar acid refinery plant now under construction. A working model, operating with water and air, will demonstrate the principles of the plate. Another model will illustrate a complete **distillery** for the production of rectified alcohol from molasses. This type of plant has also been applied to the manipulation of dates.

The range of plant supplied to the varnish industry will be exemplified by a large **synthetic resin reaction kettle.** Photographs will illustrate some of the other activities of the company in this direction, *e.g.* stand oil plant, fume removal systems and bulk varnish installations.

British Ceca Co. Ltd. will have displays showing the layout and cycle of operations of a typical *Acticarbone* **solvent recovery plant** and in addition there will be scale models of solvent recovery and **electrostatic precipitation plants.**

W. J. Fraser & Co. Ltd. will be showing a colour film of the various stages in the design, fabrication, erection, etc., of some typical contracts undertaken by the company. In addition a large number of diagrams, models and photographs will illustrate a range of specialised **process plant** items in various materials. Included among these will be a working display of a section of a Shell *Turbogrid* **distillation tray.** Another feature of the stand will be a large mural of the Anglo-Iranian *Autofining* plant at Llandarcy, together with a working diagram of the process.

Kestner Evaporator & Engineering Co. Ltd. will have models and photographs of their **evaporators, spray driers, thermo-venturi flash driers,** high-temperature **oil-heated plant, pickling plant, acid recovery** and other plant.

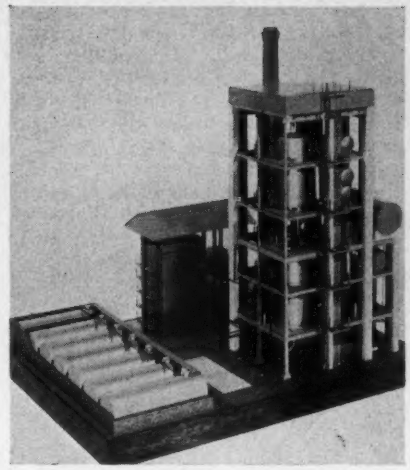
London Aluminium Co. Ltd. will show a large **sedimentation vessel,** 22 ft. long × 8 ft. in diameter, fabricated in ½-in.-thick aluminium of 99.8% purity and welded throughout by the *Aircomatic* and *Argon* arc processes. There will also be a scale model of an **acetic acid recovery plant** wherein the acid of 20 to 25% concentration passes through a column where it is extracted by solvent and fed to the main distillation column. Here crude glacial acetic acid is produced as a bottom product and purified to 99.8% minimum by re-distillation. The efficiency of acetic acid recovery is 99.5% with the exceptionally low solvent loss of 0.005 lb. per lb. of glacial acetic acid produced.

Metal Propellers Ltd. will display a **batch distillation unit** built up from standard stainless-steel components comprising gas heating jacket, still, sectional fractionating column, multitubular condenser, column top with reflux divider, and receivers. This is suitable for 50 p.s.i. or full vacuum working. The simplified and standardised design of this plant has been newly developed by the company and it is claimed that it permits the maximum flexibility of use combined with economy and speed of fabrication. Further exhibits will be examples of **bubble-cap** and **riser assemblies** in stainless steel for Glitsch 'truss-type' bubble trays.

L. A. Mitchell Ltd., in addition to the smaller equipment they will be showing, will have photographs and drawings illustrating their larger-scale **industrial drying plant** and **chemical process equipment.**

Newton, Chambers & Co. Ltd. will have on their stand a model of a 250-tons/day capacity **tar distillation plant** with needle tube pipe still. Another model will be of tower-type **gas works purifiers** of 10 million tons/day capacity, complete with Goliath crane. Further exhibits will be examples of **fuel economy equipment** (needle tube elements in heat-resisting iron) and of *Lithcote* **acid-resisting linings.** Photographs and drawings will illustrate chemical plant and by-product plant for gas works and coke ovens, including gas purifiers, condensers, washers and scrubbers; benzole recovery and refining plant; gasholders; concentrated gas liquor and dephenolation plant; fractionating columns and petroleum refining plant; storage tanks and processing vessels in mild steel and cast iron.

Peabody Ltd. are demonstrating their **scrubbers** by means of a small working model constructed in transparent materials to show the impingement plate in action.



Model of a continuous tar distillation plant to be exhibited by Newton Chambers & Co. Ltd.

Impingement plates, which form the base of all Peabody scrubbers, coolers and absorbers, will be on view, together with a small stainless-steel pilot-plant scrubber used for site testing. An **oil burner** and a combined **gas and oil burner** will illustrate the types of combustion equipment supplied to power stations and petroleum refineries. A model of a blast furnace gas burner, a gas electric igniter and other ancillary equipment will be shown. Oil- or gas-fired **air heaters** used for the production of high-temperature air for drying, liquor concentration and other processes, will be illustrated by a cut-away model. There will also be a graphic panel showing fuel, air and product flows, demonstrating the way in which automatic control can be applied to drying processes using an air heater.

Power-Gas Corporation Ltd., Ashmore, Benson, Pease & Co. and Rose, Downs & Thompson Ltd. will display photographs of a wide variety of installations and equipment supplied to the chemical, gas, iron and steel, fatty oil and petroleum industries. These will be supplemented by a model of a **hydraulic controller, power cabinet and valve** such as Power-Gas regularly install with their gas plants which operate on cyclic processes. In addition, a working diagrammatic model of a Wiggins **dry seal gasholder** will be shown. There will also be a small Rosenblad **spiral plate heat exchanger** and a number of *Meehanite* castings, one of which will have been machined to show the excellent machining qualities of this material. The latest development in solvent oil extraction for oilseeds and other oleaginous material is illustrated by a semi-working model of Rosedowns' **rotary continuous extractor.** This model is exhibited as part of

a relief diagrammatic flowsheet of a complete plant, so that the visitor can follow the operation of the extractor and its auxiliary equipment for the recovery of the solvent from the oil and the residual meal. Rosedowns will also show a model of a *Maxoil-Duplex* **oil expeller.** An *Argon* **arc welding set** such as Ashmore, Benson, Pease regularly use for pipe fabrication on chemical plant will be shown, as well as a specimen of a welded pipe joint which has been tested to destruction. Samples of **crystals** produced by the *Krystal* process will be available for inspection together with a selection of Rosedowns' **hydraulic leathers.**

George Scott & Son Ltd. are including in their exhibits a gas-heated **pilot spray drier** constructed in polished stainless steel and complete with dust recovery unit; a **forced circulation heater** designed for continuous heating of heat-sensitive liquids up to 270 to 280°F.; a **vacuum drying stove** with stainless-steel contact parts and cavity shelf heating plates, operating up to 29½ mm. Hg. vacuum; and a vertical **stirrer pan vacuum drier** in stainless steel with steam-heated hot plate and jacketed shell. There will also be a model of a De Smet **continuous extraction plant** for vegetable oil seeds and similar oil-bearing materials, and a model of an **evaporating plant** for general purposes.

On the same stand, *Henry Balfour & Co. Ltd.* will show various models of **gas works plant.** There will be models of **tower purifiers** capable of handling 7½ million cu.ft./day of gas, of **gas condensers** and also of a **static washer.** A small working model will demonstrate the operating mechanism of a **water-gas unit.** For the oil industry, a heat exchanger will be shown.

Also on the same stand *Enamelled Metal Products Corporation* (1953) *Ltd.* will show some of their *Pfaudler* glass-lined chemical equipment, including a complete **distillation unit** comprising jacketed reaction kettle, condensers, receivers and connecting pipe, all constructed in glass-lined steel. Various small items of **glass-lined plant,** such as valves and piping, will also be shown, as well as a 500-gal. stainless-steel **reaction kettle** for high-pressure work.

Thompson Bros. (*Bilston*) *Ltd.* will feature a stainless-steel **powder wagon.** This consists of a rectangular box with the bottom shaped to form a hopper about 8½-ft. long, 4-ft. wide and 4-ft. deep. A screw conveyor for discharging is fitted through the hopper portion and the whole unit is mounted on four wheels. A 1,500-gal. stainless-steel **agitated pressure vessel** will also be on view, this being made of 18/8/Ti stainless steel and measuring 6½-ft. inside diameter and 9-ft. high. The top is dished and the bottom conical, and two stainless-steel coils are fitted. The agitator is of conical shape with a hole down the centre to give circulation over the coils. A 6-h.p. electric motor provides the drive through a 10-in. centres worm reduction gear. Another feature of this stand will be a 150-gal. vertical jacketed **mixer** made in stainless steel with a mild-steel jacket. It is fitted with anchor stirrer, fixed baffles and hinged lid. The drive is from a 12-h.p. motor through a worm reduction gear unit. Other equipment on display will include a section of a 43-ft. long stainless-steel **bubble cap column** and a stainless-steel **calandria** 10 ft. 7 in. in diameter and 6-ft. deep.

Whessoe Ltd. are exhibiting their wide range of plant and processes. The first section will illustrate **steel plate construction** for the chemical and other industries. Also shown will be **steel structures** built for the petroleum refining industry and a model of two overhead **spirit storage tanks** designed for the rapid filling of road tank wagons. There will be a section devoted to **gas cleaning,** the whole process being reviewed as unit operations (condensers, detarrers, scrubbers and purifiers) and as integrated sequences carrying out the complete process. High- and low-pressure **gasholders** will also be featured. Perhaps the most notable exhibit will be an actual **heat exchanger** sectioned to show particular constructional features.

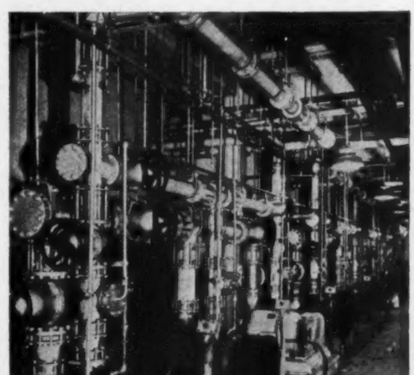
Machinery, Apparatus and Constructional Materials

Baker Perkins Ltd. will display **mixing machines** representative of the comprehensive *Universal* range which embraces machines in 19 standard sizes from 1½ pints to 2,200 gal. per mix and includes many types and classes for mixing under vacuum and/or pressure and with troughs jacketed for steam or brine circulation.

Birlec Ltd. will display four *Lectrodryers* for reducing the moisture content of air (particularly compressed air), other gases and certain organic liquids. They are used directly in the manufacture or supply of oxygen, nitrogen, hydrogen, chlorine, carbon dioxide, hydrochloric acid, ozone, acetylene, phosphorous oxychloride, butane, ether, carbon tetrachloride, etc. In these and similar applications the water vapour is removed to maintain an inert or reducing atmosphere, to prevent hydrolysis or to prevent freezing at low temperatures. Dry air is also used to dry storage bottles, refrigerator tubing, etc., after hydraulic-pressure testing.

British Acheson Electrodes Ltd. plan to show a selection of chemical equipment in *Karbate* impervious graphite. This will include a **cascade cooler** consisting of a series of 2-in. i.d. pipes each 9-ft. long, erected in a vertical position to permit water to cascade down the outside of the tubes. There will also be a **centrifugal pump** of 50 gal./min. capacity, with the front cover open to show the impeller assembly. A novel feature is the *Karbate*-to-*Karbate* seal ring. Another exhibit will be a **tube bundle heat exchanger** of standard size, incorporating 31 9-ft.-long tubes, ⅞ in. i.d. and 1¼ in. o.d., giving a total of 92 sq. ft. effective heating area. An example of an **immersion-type heat exchanger** will be shown mounted in a sectionalised corner of a pickling vat. This unit is extremely adaptable, being easily placed in or removed from a vat. *Karbate* tubes, globe valves, steam injectors and ejectors, pipe bends, T pieces, crosses, etc., will also be on view.

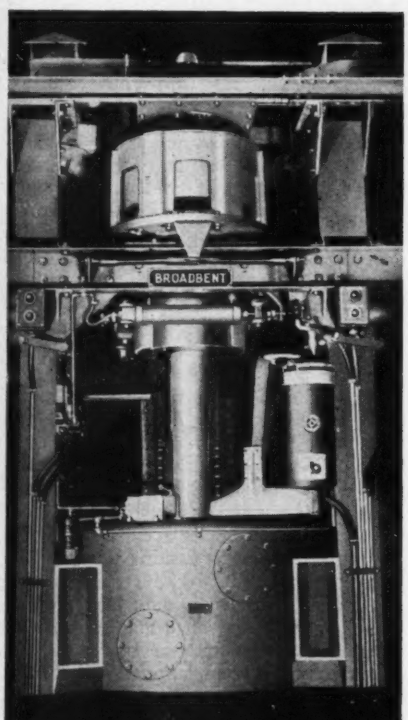
Thomas Broadbent & Sons Ltd. will present, for its first appearance at an exhibition, a new **sugar centrifugal.** Features of this machine are: the forced-ventilated motor built direct on to the main centrifugal spindle without an intermediate flexible coupling, and the highly efficient braking giving reduced time cycles, which is electro-dynamic from full to half speed and controlled by a process timer. Air-operated mechanical braking is automatically applied to stop the machine. Finger-tip control gives easier and faster massecuite feed through a power-operated gate-type valve specially designed to prevent sticking, and emergency hand gear is fitted to close the valve in the event of a power failure. The basket has received special attention and incorporates a discharge valve of revolutionary design. Hand control is unnecessary as this valve is an integral part of the basket and opens automatically when the plough is brought



Doulton slurry transfer pumps and pipe lines at the catalyst plant of Joseph Crosfield & Sons Ltd.

into operation and automatically closes when the plough is returned to the locked position. The plough discharger gives high efficiency with minimum manual effort. Safe operation is guaranteed and the plough is locked in position when not in use. The omission of the standard type of ploughing equipment leaves a particularly clean basket top. The master controller designed for finger-tip control from start to end of spin has two levers operating in clearly marked gates to control the machine speeds and process timer and the massecuite feed, respectively, and power-operated washing jets, automatically controlled by the process timer, are arranged to give an even wash over the total cake depth. This washing system dispenses with the normal practice of inserting perforated pipes and leaves the basket interior absolutely clear.

Another exhibit will be the 30-in. type 80 inclined **ploughing centrifugal.** This has been successfully applied for batch treatment and can be operated semi-continuously, as feeding, separating and discharging are all carried out with the machine running. Manual work is reduced to a minimum, as the contents of the basket are discharged by a ploughing gear. When used for freely-filtering materials, *i.e.* sodium sulphite and nitro-cotton, a perforated basket is used and an imperforated basket is used for slurries that do not filter freely. For processing solids which settle out easily under centrifugal force, a

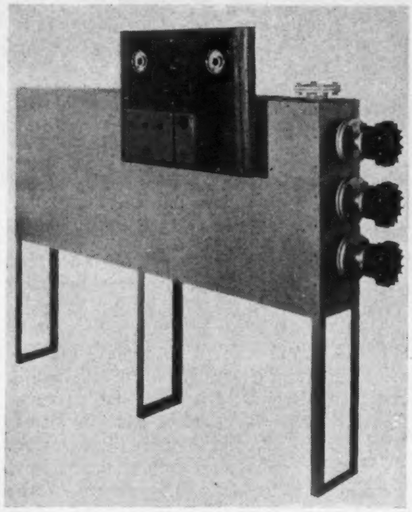


New Broadbent high-duty centrifugal with forced ventilated motor, Poppleton automatic discharge valve, finger-tip control and automatic process timing.

skimmer attachment is used and the machine adapted to work on the continuous-feed principle, spilling the liquid over the lip and resulting in a very high output.

The plough can be power operated, full-width type or hand-operated traversing type according to the material processed, and standard machines can be modified to run at high and low speeds for centrifuging and feeding and ploughing respectively. Suitable constructional materials are provided for special applications, and the standard sizes offered are 21 in., 30 in., 36 in., 48 in. and 60 in. basket diameter.

The automatic centrifugal clutch coupling to be exhibited is applied for giving



Typical of the equipment to be exhibited by Hygrotherm Engineering Ltd. is this 18-kw. electric heater, showing heater casing, three-element contactor box and temperature regulators for automatic control.

smooth, shock-proof transmission and combines simplicity and reliability with exceptional efficiency. Working parts are confined to a driven half and a driving half carrying four loose shoes lined with *Ferodo* on the outer face. As the motor speed increases, centrifugal force throws the shoes radially outward, and they engage the driven half, gradually accelerating it to full motor speed.

Cannon (CP) Ltd. will be displaying a selection from their range of chemical plant made of cast iron and lined with hard grey acid-resisting glass enamel. This will include a 50-gal. **distillation plant,** complete with a 15-sq.ft. sectional-type condenser, a 25-gal. receiver and enamelled pipes and valves. Other exhibits will include a 250-gal. steam-jacketed **mixing vessel,** a 500-gal. **inner pan,** open-top **steam-jacketed pans** of both the shallow and the deep type and of various capacities, various types of **agitators** and a selection of enamelled **laboratory equipment.**

John C. Carlson Ltd. will have exhibits representing their range of **sheet filters,**

S. H. Johnson & Co.'s six-chamber, 6-in. square 'TRI' type experimental laboratory filter press.

which are available from small *EK* laboratory units designed for the small-scale clarification or sterilisation of toxins, injection solutions, plasmas, etc., to the larger 40-cm. and 60-cm. units. These are used for the filtration of beer, vinegar, varnishes, water and other liquids and are readily adaptable by the addition of spacer frames for dealing with suspensions containing relatively high concentrations of solids such as plating solutions. Another feature of the display will be a number of **alluvial filters** and **cylinder filters** of various sizes and types. Further items will include a **bottle-soaking and washing machine, filling machines,** a range of **tincture presses** incorporating several novel features and a number of stainless-steel **taps** and **connections.**

Dexine Rubber & Ebonite Ltd. are featuring a hard rubber **centrifugal pump** which incorporates a new rotary seal in place of a gland. This eliminates gland troubles, being particularly advantageous when handling sodium hypochlorite and hydrochloric acid. Also on show will be a hard-rubber **rotary gear pump,** hand- and power-operated **reciprocating pumps,** a **carboy pump** and a new solid hard-rubber **diaphragm pump** which has all working parts enclosed in rubber casing. Another exhibit will be a display of Dexonite-Saunders diaphragm valves for use where metal valves are unsuitable owing to corrosion.

Doulton & Co. Ltd. will exhibit a number of representative items from their standard range of acid-proof chemical laboratory porcelain, chemical stoneware and porous ceramics for filtration, diffusion and electrolytic processes. Among the special features of this stand will be a pipeline **filter unit**

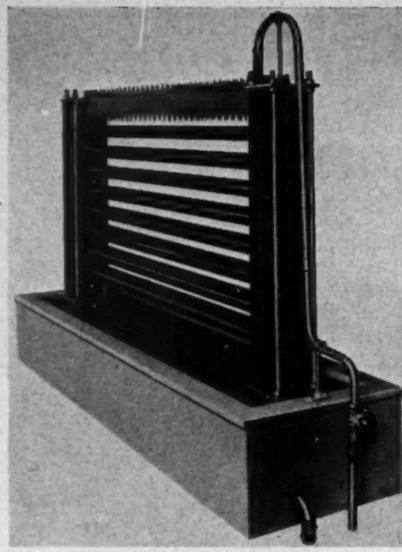
embodying porous ceramic filter elements, $1\frac{1}{2}$-in. 'fixed-flange' chemical stoneware piping and a diaphragm pump. The arrangement of piping in this demonstration is a condensed version of that employed in practice for batch filtrations, but for convenience the liquor is being recirculated.

Air-lift agitation with porous ceramic diffusers will be demonstrated. A single 10 in. × 2 in. grade *G5* porous ceramic element produces agitation of a liquid with increased mixing efficiency by means of an air-lift, using approximately 12 cu.ft./min. of free air at low pressure. The arrangement to be shown is simple and can readily be incorporated in existing plant. The same principle can be applied to transfer liquid from one vessel to another. A chemical stoneware supply line for the air guards against corrosive conditions and prevents contamination of the liquor. Another exhibit will be a salt-glazed acid-proof **stoneware jar** of 440-gal. capacity, fitted with cover and outlet cock. It is suitable for the storage or processing of corrosive or other materials where absolute purity is required. There will also be a section of a typical cream-glazed stoneware **vacuum filter** of total capacity 36 gal., fitted with a porous ceramic filter plate. A motor-driven bench-type **ball mill** by Steele & Cowlishaw Ltd., fitted with Doulton porcelain mill jar and grinding balls, will be another feature. Finally there will be Doulton piping, pressure filter units, kieselguhr and porcelain candles, ceramic tubes, tiles and plates.

Wm. Gardner & Sons Ltd. are exhibiting the latest design of *Rapid* **sifter and mixer.** This has been entirely re-designed to give increased facilities for cleaning, by making the internal agitator, as well as the brush and sieve, completely removable without disturbing any of the drives. A laboratory-size mixer which will also be exhibited is of generally similar construction, embodying the same principles of access for easy cleaning.

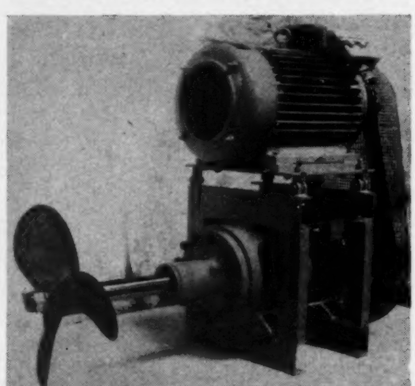
A further machine of an entirely different design for the mixing of dry powders and granular materials will be a **double-cone blender.** This has been specially developed for handling materials which are not easily mixed by the standard trough-type mixer with internal agitators. The machine consists of a specially designed double-conical drum, and the mixing is achieved by the rotation of this drum on an axis at right-angles to the conical portions. Owing to the fact that there are no internal agitators in the machine, it is easy to clean. On the smaller sizes the drum is made in halves so that one half can be removed completely and the machine washed down.

Finally an improved design of **paste mixer** will be shown, this being a self-contained unit with inbuilt motor drives and arranged for tipping.



This 'Carbinert' cascade cooler, to be exhibited by Morgan Crucible Co. Ltd., is for cooling corrosive gases or solutions

Hathernware Ltd. are making a display of their acid-proof **chemical stoneware,** including towers, tanks, tiles, pumps, pans, ejectors, valves, filters, pipelines, grinding mills, and **chemical porcelain,** including *Minifilters*, jugs, funnels, Raschig rings and Berl saddles. Special attention will be drawn to armoured items of stoneware plant and combinations of stoneware tiles with acid-resisting cements and jointing compounds. The centre of the stand will consist of a fabricated mild-steel tank lined with buff stoneware tiles set in acid-resisting cement, on a base of acid-proof stoneware floor tiles. A stoneware centrifugal pump will draw liquor from the tank, the head obtained providing motive power for a stoneware ejector which induces suction through a stoneware tower. This ejector, of the swirl type and completely armoured, is capable of handling a large volume of fumes. A smaller armoured ejector actuated by liquor drawn from the tank by another stoneware pump will demonstrate maintaining suction on a stoneware vacuum filter, the bottom portion of which is encased in welded steel for protection. Pipelines for the pumps and ejectors are of armoured stoneware. The stoneware tower, approximately 12 in. i.d. × 7 ft. high, is a small edition of an absorption column which can be made in stoneware up to approximately 5 ft. i.d. The sections of the stoneware tower have cone flanges, the faces of which are ground to give an airtight seal without the use of any jointing material.



A large side-entry mixer, made by L. A. Mitchell Ltd.

A stoneware pipe ventilator with ducting and hood will draw fumes from a miniature reaction tank made in *Heatware* heat- and acid-resisting stoneware. Different sizes of tower packing rings and Berl saddles will be shown and other exhibits will include a sectionalised screw-down valve showing the stoneware lining, an opened-up stoneware pump with a series of impellers, a hand-operated diaphragm-type stoneware pump and a roller mill with porcelain grinding jars in operation. There will be a selection of smaller units from the very wide range made in this material.

Honeywell-Brown Ltd. will be exhibiting a comprehensive range of instruments designed to meet the increasing demands for closer process control which are being made by so many branches of industry. In addition to *ElectroniK* **potentiometers** and *Protectoglo* **combustion safeguard systems,** certain newly-developed instruments will be on view. These include a new system of **electronic modulating control,** a **differential converter,** diaphragm-type **pneumatic flow transmitters** and associated conventional and miniature receivers.

Hygrotherm Engineering Ltd. will illustrate the type of plant that can be used to provide **heating** and **cooling** to a small pilot plant requiring reaction temperatures up to 350°C. The unit on their stand will be operating at this temperature on a closed circuit and will be available for inspection. The unit comprises a 24-kw. electrically-heated generator through which is force-circulated an organo-silicate heat transfer fluid marketed as *Tetra Aryl Silicate* 180. The electric heating elements are specially rated for this service and are contained in a continuous pipe nest so that the liquid passes over the heat transfer surface at high velocity. The circulating pump is directly driven by an electric motor and the unit is specially designed for high-temperature heating service. The interconnecting pipework incorporates control valves, expansion tank and thermostatic controls, and the whole unit is self-contained ready for use by connecting a correctly designed jacketed vessel, heat exchanger or other heat-using device. Examples of heating and cooling with 'liquid heat,' which is used over a temperature range of –50 to 350°C. in a low-pressure, all-liquid system, will be illustrated by photographs of actual plants.

Physical property data of various liquids are given and attention is drawn to other possible uses of organo-silicate liquids for heat transfer or power engineering.

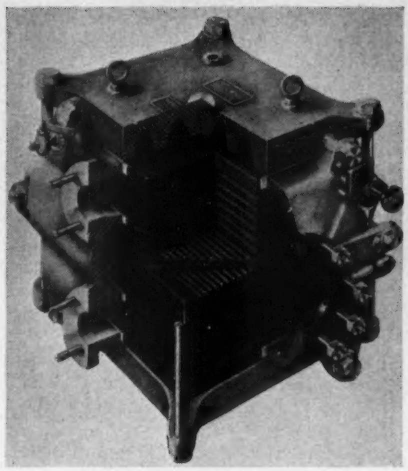
Isopad Ltd. will have on show their special electric **heating mantles** for keeping valves at elevated temperatures, thus avoiding coagulation of the contents. They are also used for maintaining process gases at the correct temperature. One of the exhibits will be a heating mantle for a special 3-in. bore valve. The mantle is made in two halves which are hinged together and can thus be easily fitted over the valve on site. Other exhibits will include *Isotapes*, these being flexible, fully-insulated **heating tapes** used for pipe tracing and for the heating of columns. For heating large tanks, heating panels can be used, and assemblies of these will be exhibited.

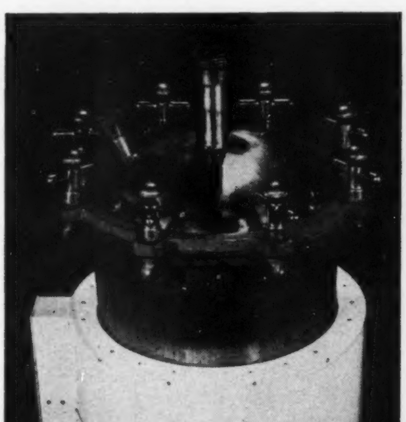
S. H. Johnson & Co. Ltd. will have on their stand a number of models illustrating their larger equipment, together with laboratory models. They will be exhibiting small **filter presses** constructed in cast iron, stainless steel, gunmetal, ebonite and different types of timber. There will be a **diaphragm pump** and an electrically-operated hydraulic screw bush mechanism for closing filter presses. The laboratory exhibit will include an hydraulic **squeezing press**, a pneumatic **laboratory filter** and an enclosed type of filter for spiritous extraction. A wide range of **filter cloths and papers** is also to be shown, including examples made up from synthetic materials.

Kestner will also be exhibiting some smaller items of plant such as **automatic gas washers, fans, pumps** and **stirrers. Constructional materials** such as *Keebush*, PVC, polythene, silicon iron and lead will also be on view.

L. A. Mitchell Ltd. propose to exhibit a range of **pumps** for the chemical and process industries, for handling acids and liquids where freedom from metal contamination is desired, and also **fluid agitators** and **mixers** of various types, including direct electrically-driven portable models of the high- and low-speed types, **laboratory stirrers** and large **side-entry mixers.** Small-scale manufacturing equipment displayed will include a **resin kettle** in stainless steel, a high-pressure **autoclave** and a steam drum **drier.** There will also be a hot-air tray **drying stove** arranged for steam heating, and a hot-air **drying cabinet** electrically heated, together with a range of **drying trays.**

Morgan Crucible Co. Ltd. will have working exhibits of equipment made of *Carbinert* impervious carbon and graphite, including **cascade coolers,** which are available as single, double, triple or quadruple units and are used for cooling both corrosive liquids and gases. Typical applications are the heating of steel pickling solutions and the cooling of hydrochloric acid. Another item of equipment in which this material is used is a **bundle heat exchanger,** the *Carbinert* components being enclosed in a steel shell. There is a range of sizes up to a maximum of 44 tubes of 1¼-in. o.d., ⅞-in. i.d. and 6-ft. long bonded into 15¾-in. diameter end plates. Plate and bayonet heaters are also made in this material. The plate heaters are in the form of a block internally machined to a series of convolutions to carry the steam, ribbed externally to give an increased heating surface. The bayonet heaters are flanged *Carbinert* tubes blocked at one end and are a compact steam heating unit capable of withstanding internal steam pressure of 40 p.s.i. Other exhibits show how this material is used in the chemical and textile industries.


Powell Duffryn graphite cubic heat exchanger.


Stainless steel vessel with a 'Stabilag' heating jacket.

Powell Duffryn Carbon Products Ltd. will also exhibit carbon and graphite equipment. They will show models from their range of highly compact **cubic heat exchangers,** having heat transfer areas from 10 to 100 sq. ft. These robust units, designed to eliminate fragile tubes, are based on a 9-in. or 15-in. cube of graphite, perforated by two separate series of holes running at right-angles to each other through the block. They operate with high overall transfer coefficients as heaters, coolers or condensers for most acids, alkalis and solvents. The units may be simply coupled together and can handle a wide range of throughputs by using suitable headers. Evaporation equipment shown on this stand will be block-type **calandria units** for incorporation into climbing-film, forced- or natural-circulation evaporators, for single- or multiple-effect operation. Their high performance and compact size makes them particularly suitable for concentration of sulphuric and phosphoric acids, alkalis, metallic salt solutions, yeast extracts, hydrolysed protein, fruit juices, etc. Sections of *Paragrid* **tower packing** for scrubbing and absorption towers, cooling plant, distillation columns, HCl absorbers and other applications will be another feature of this stand. Ancillary plant on view will include **injectors, ejectors, pumps, carbon tiles** and **cooling linings.**

Premier Colloid Mills Ltd. will show their range of high-speed **colloid mills** and paste-type colloid mills. There will also be a complete range of **mixers** for handling quantities of liquids from 5 to 5,000 gal. The successful *Dispersator* **mixing head** will be on show in various sizes. Also on view will be some of the apparatus used in determining the physical factors encountered in developing high-speed mixing equipment. The stroboscopic equipment used to slow down high-speed plant should be of particular interest.

Prodorite Ltd. will be showing a full range of acid- and alkali-proof **cements** such as *Cement Prodor* and *Asplit*. There will also be **pickling** and **plating tanks** complete with floorings and channels and effluent neutralising schemes. A further section of the display will be devoted to fabricated plastic constructions such as **fume ducts, hoods, extruded tubes** and the like, largely in rigid PVC. There will be **anti-corrosive protective coatings** applied to metal and in some instances metal and concrete such as *Prodor-Glas* and *Prodor-Film*.

Quickfit & Quartz Ltd. will exhibit a large, all-glass **vacuum still,** using steam as the heating medium. This still, which will be demonstrated in operation, includes multiple **heat exchangers** using steam at 50 p.s.i.g. to provide reboil heat, packed **column sections** and **total condenser, reflux control** and **vacuum offtake**

system. Among its main features are the use of reboilers in circulatory arrangement for better thermal circulation and shorter contact time, the use of column sections in various sizes to facilitate modification to platage, accommodation for a wide range of reflux ratios (which may be varied during operation to give constant overhead product during batch working) and the use of intermediate and final **vacuum receivers** so that product may be withdrawn without shutting down and breaking vacuum. This type of unit provides the high degree of flexibility required in development and pilot-scale work and, in addition, is finding wide use as production-scale plant in manufacturing fields where purity and close control of product are essential requirements.

A second exhibit will demonstrate some of the characteristics of **column packings** with regard to their capacity to operate under various vapour and liquid loadings without flooding. This type of equipment, in which visual examination of column contents is possible, provides a valuable instructional and research tool for use in fields where inter-phase contact—either liquid/vapour or liquid/liquid—is of interest. For reaction and distillation work outside the temperature range in which steam heating is effective, a series of electrically-heated plant units are available. One such plant, fitted with the recently developed gas-purged heating mantle, will be on show. This plant provides for reaction under total reflux, with stirring, gas-bleed and temperature measurement, followed by distillation under atmospheric or reduced pressure, and the heating equipment is temperature-controlled and nitrogen-purged.

Smaller individual items exhibited will include an all-gas **safety valve,** a hinged flap **non-return valve,** special **stopcocks** for pressure operation and a **heat exchanger** designed to remove exothermal heat from reaction vessels.

Rhodes, Brydon & Youatt Ltd. will be exhibiting **process pumps** of both the horizontal and vertical types. Under the first heading there will be an improved range of pumps of capacity up to 500 gal./min. and heads up to 240 ft. These are available in a wide range of special materials, with mechanical seals or packed stuffing box. The range is standardised, thus reducing the number of different parts to a minimum. Features include centre-line suspension with top suction and discharge, case wear rings and spacer-type couplings allowing removal of impeller and bearing assembly without disturbing the pipework. Various other special features are available, such as the water-cooled stuffing box, impeller wear rings, etc. Vertical *Mopumps* for tank or sump transfer duties will be on view, with flange mounted in the tank or outside to provide a glandless pump assembly. The display will include a wide range of designs and special materials for handling liquors up to 500°C. Capacities in this range are up to 3,000 gal./min. and heads up to 180 ft.

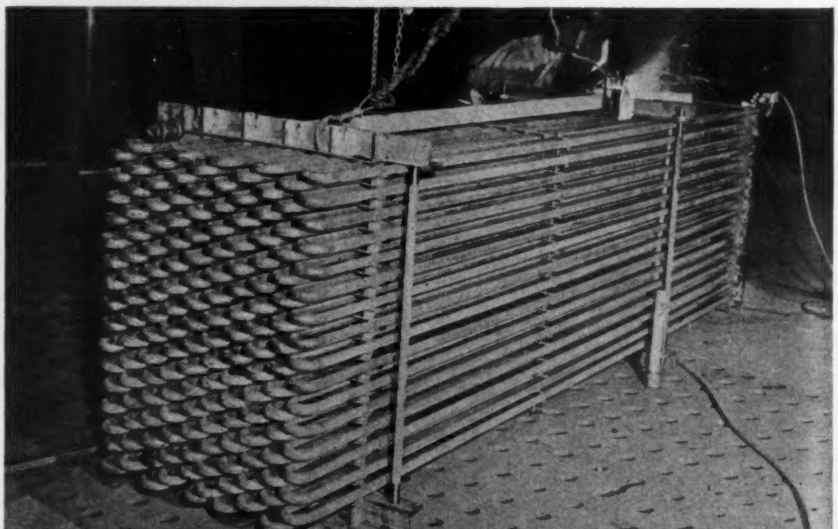
Russell Constructions Ltd., who are specialists in the application of gyratory vibration to the mechanical processing of materials, will be showing a *Finex* stand model **sieving and straining machine,** a compact mobile unit used in the food and chemical industries. Another exhibit, the *Finex* variable-speed machine, is an improved version of the stand model, incorporating a torque converter affording speed variations between 1,000 and 3,000 r.p.m., since it has been found that the greatest sieving and straining outputs occur at highly critical vibration speeds. The machine is used for the sieving of difficult powders or the straining of highly viscous liquids. The Russell **cascade sieve,** also to be on show, provides a means for the bulk sieving of materials such as flour where continuous automatic evacuation of reject material is called for.

Shaw-Petrie Ltd. are exhibiting **mild-steel, alloy-steel** and **non-ferrous-metal piping assemblies.** They have had considerable experience in the fabrication and erection of all manner of pipe assemblies for the chemical, gas and petroleum industries, using traditional cold and fire bends in conjunction with welded fabrication up to and including 30-in. diameter. They are specialists, however, in the more modern technique of all-welded construction using forged seamless butt welding fittings, manufactured by their associated company, Clyde Tube Forgings Ltd. This type of fabrication is made possible by the use of a full range of welding fittings in sizes up to 24-in. diameter.

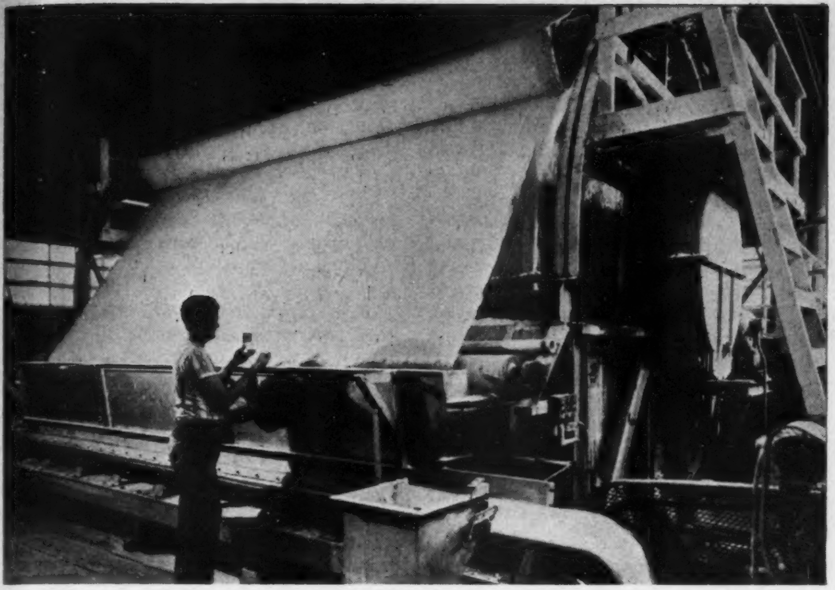
The exhibits will consist of pipe assemblies fabricated in copper, aluminium, stainless steel and Monel metal using welding fittings of the requisite material. Special forging and welding technique has been evolved by the firm to meet the special conditions applying to these non-corrosive materials. Mild-steel pipework assemblies will also be on view showing typical cold and fire bends, as well as steam-jacketed piping using welding fittings which reduce the use of flanges to a minimum. Examples of pressure vessels and heating and cooling coils, together with a comprehensive range of welding fittings and welding test pieces, will make up a thoroughly comprehensive display of pipework for the general chemical industry.

The Stabilag Co. Ltd. are showing a wide range of moulded and uniformly heated high- and low-temperature **electric jackets** and **control equipment,** covering many laboratory and industrial applications. The exhibits will include a synthetic resin pilot plant, heated and controlled by *Stabilag* jackets, and a rubber-lined rectangular tank with a *Stabilag* heater as a lamination, for heating low-temperature corrosive materials. A range of laboratory-scale heating jackets will be shown, complete with temperature control equipment and distillation glassware.

Another exhibit will be a high-temperature distillation plant for use in highly inflammable areas. This plant will be nitrogen-gas-purged; it is an approved system, and complies with the Factories Safety Regulations. Other features of this stand will be a range of heated piping, using various types of electric heating tapes and pipe jackets; and a drum heater, thermostatically controlled for heating greases, heavy oils, waxes, paints, resins, tar, varnishes, plastics and gelatinous materials up to 400°F.



Shaw-Petrie 1-in. bore mild steel heat exchanger coils being finally assembled. Similar coils will be seen at the exhibition.



A 'FEinc' string discharge rotary vacuum filter. A small filter of this type is to be exhibited by Stockdale Engineering Ltd.

Stainless Steel Vessels (London) Ltd. will have an exhibit of unusual interest in their *Aeratone* **therapeutic bath,** one of the latest introductions in the field of hydrotherapy and claimed to be a powerful aid in the treatment of circulatory and rheumatic disorders. Although termed a bath, it is at the same time a powerful machine combining air, massage, warmth and water and provides for the application of a vibrating hydraulic massage, variable in strength at will, to all parts of the immersed human body simultaneously, at a comfortable temperature and under conditions of complete relaxation for the bather. The bath comprises three pieces of equipment: the bath itself, which can be of either the vertical or horizontal type; the control desk or panel; and the air compressor unit. The control desk carries various gauges and valves with which to control the conditions in the bath. The air compressor is of the sliding-vane blower-type driven by an electric motor.

Stockdale Engineering Ltd. are showing a small stainless-steel **rotary vacuum filter** with string discharge, of the *FEinc* design but made by the company in their own works. Other exhibits will include turbine-type **agitation equipment** complete with motor and gear box, a *Vanton* **Flexiliner pump** and a **centrifugal pump** in mild steel lined with stoneware. Stockdale will also have a display of **valves** which will include a range of 'Y'-type valves in different metals and also a range of pinch valves. The stand will also include examples of fabricated **lead coil** and of mild-steel lead-lined **piping.**

The Thermal Syndicate Ltd. will show equipment for the manufacture of pure acids, including *Vitreosil* all-silica **burners** for combustion and hydrogen S-bend **coolers, absorption vessels** and **tower sections.** There will be **distillation units** for pharmaceutical quality acids and, for pure chemicals production, large *Vitreosil* industrial **evaporating basins,** heat-treatment **crucibles** and **trays, pipes** and **tubes.** Also on display will be **pyrometer tubes,** used in the quick immersion thermocouple method for determining the temperature of liquid irons, steels and alloys, and as targets for optical pyrometers. *Vitreosil* acid-proof **immersion heaters** for heating acid liquors in pickling tanks and electroplating baths will also be shown.

Chemical Engineering Exhibits in the Engineering and Marine Exhibition

Many of the stands in the main Engineering, Marine and Welding Exhibition, of which the Chemical Plant Exhibition is a part, will show exhibits of chemical engineering interest. Here is a description of these exhibits.

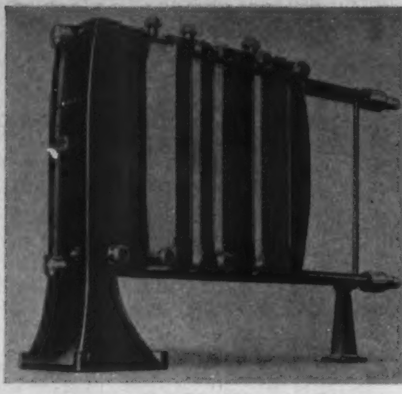
Accles & Pollock Ltd. will display **intricate coils** made from stainless steel for chemical plant purposes, examples of **stainless-steel tube** in the 'as drawn' and polished condition and a comprehensive display of tubular **box spanners** and **wrenches.** There will also be specimens of special section **seamless drawn tube** in many shapes and of tubes produced with a very high standard of finish in the bore for hydraulic lifting tackle.

Accurate Recording Instrument Co. will exhibit their *Thermonitor,* a small instrument claimed to indicate and control with great accuracy (using a 5-amp. 230-v. Microswitch or pilot valves, etc.) any practicable temperature band between −240 and +400°F. It is fully compensated for ambient temperature changes and even with 80 ft. of capillary accuracy is guaranteed within 1% of the scale. The powerful liquid-expansion system ensures positive operation of both the pointer and the control mechanism and ensures also that both will always operate exactly together. The instrument may be set in a moment to turn switches, valves, etc., either on or off at any desired point on the scale, and to do so on either a rising or a falling temperature.

Alfa-Laval Co. Ltd. will show, for the first time, three new types of De Laval centrifuges. One of these is a 'nozzle'-type **centrifugal separator** for the continuous three-way separation of light liquid, heavy liquid and solids. This machine represents a complete range of new continuous two- and three-way separators with the 'nozzle'-type bowl for the continuous discharge of solids, used for starch, protein, vegetable and fish oils, etc. Another machine on this stand will be an entirely new **centrifuge,** type PX, with self-opening bowl for the automatic discharge of solids. It is claimed by the makers to have an efficiency as high as the biggest standard 'purifiers.' Thirdly, there will be a new De Laval **desludger.** This is a horizontal centrifuge and the bowl is fitted with a helical screw rotating at a different speed. Continuous discharge of solids is effected in this way. **Plate-type heat exchangers** and **centrifugal pumps** will also be on show and the standard range of De Laval **oil purifiers** will be demonstrated.

Audley Engineering Co. Ltd. will have a display of lubricated **plug valves** for operation on most line fluids at pressures up to 5,000 p.s.i. and temperatures to 650°F. There will be valves in steel, cast iron, stainless steel, *Monel, Audcoloy,* bronze, aluminium and plastics in sizes from ½ to 18 in. Information will be available at the stand regarding the new **valve lubricant,** No. 631 (CHEMICAL & PROCESS ENGINEERING, July 1953). There will also be a working exhibit of a remotely-controlled **power-operated valve** and also a steel **Christmas tree assembly** as supplied for oil wells in the Middle East.

Auto-Klean Strainers Ltd. are showing **self-cleaning filters** for all liquids, **self-**



Alfa-Laval plate type heat exchanger.

cleaning strainers and **fine-mesh filters** with capacities of from 1 to 100,000 gal./hr. Another exhibit will be the recently patented Auto-Klean *T.K.* which offers fine mesh with the self-cleaning feature and is now available over a wide range of capacities. The *Flushflow* and *Lolos* strainers, which are particularly suitable for abrasive liquids, will also be on show.

Babcock & Wilcox Ltd. will have as the main feature of their stand a large diorama depicting their range of boilers and other equipment for power stations, factories, oil and chemical plants and shipping. Photographic transparencies will show typical land and marine **boiler plant, mechanical handling equipment** and **fusion-welded pressure vessels.** Other exhibits include detailed models of land and marine **boilers,** including a model of the largest boiler ever constructed in Great Britain and a working model demonstrating new developments in the mechanical handling of washery slurry at a large power station. Another working model demonstrates the operation, within the steam drum of a boiler, of the *Cyclone* **steam separator.** The exhibits will include also models and displays depicting **thimble-tube boilers** made by the Clarkson Thimble-Tube Boiler Co. Ltd. and **waste-heat boiler plant** made by Spencer-Bonecourt Ltd.

Bayham Ltd. are showing examples of their range of *R & G* **fluid measures, level controls** and **flow indicators.**

The main feature of all these instruments is the magnetic drive which transmits the required rotational movement through the solid body of the instrument, thus separating the control or indicating mechanism from the liquid and ensuring total elimination of leakage under pressure and vacuum conditions. The importance of this feature will be particularly appreciated when corrosive liquids are being handled.

A working exhibit will demonstrate the automatic control and indication of liquid at varying levels and flows by means of instruments constructed largely in transparent materials, allowing the operation to be studied in detail. In addition, typical contents gauges for direct mounting on storage tanks will be seen. Special fluid measures for use under low-temperature and high-pressure conditions will also be on show. These have recently been developed for quantity indication on tanks containing liquefied gases.

Beldam Asbestos Co. Ltd. will have a display of **gland sealings, packings** and **jointings,** including moulded self-sealing gland rings and cut joints in a variety of shapes and sizes. *Lascar* **protective clothing** and **mechanical rubber goods** will complete the display.

Keith Blackman Ltd. are exhibiting marine-type axial and centrifugal **fans,** various blowers, propeller fans, a centrifugal fan for handling gases at high temperatures and a range of **fan equipment** for special applications such as fume and dust removal, the handling of noxious gases and transformer cooling. Also on display will be **unit heaters** of the gas-fired and steam-heated types and a small selection of industrial gas equipment.

Two sizes of bifurcated fan are to be shown, one a 12-in. standard type and the other a 16-in. insulated type. Both embody the design feature of the split fan casing opened out to form a separate chamber for housing the motor, thus making it readily accessible and protecting it from the temperature and fumes in the surrounding duct.

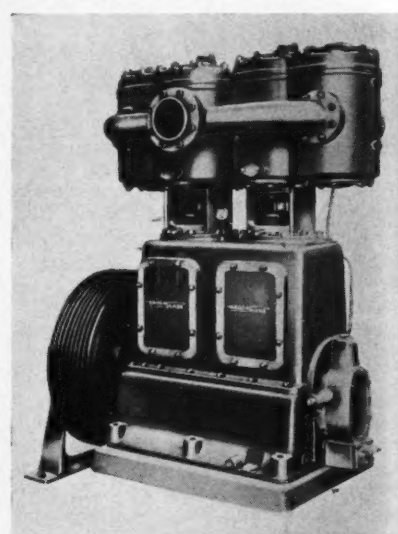
British Rototherm Co. Ltd. will be exhibiting a range of dial **thermometers, recorders** and **controllers.** There will be bi-metal actuation thermometers with a wide variety of dial ranges, presentations, stem lengths and diameters for marine, industrial and laboratory purposes. Mercury-in-steel thermometers will include distant-reading and rigid stem-models, with 4-, 6- and 8-in. dials for wall or panel mounting. New-styled indicator cases will be on view and thermometers for special applications in industry. There will also be mercury-in-steel temperature recorders of the single- and dual-pen types, vapour pressure thermometers including distant-reading and rigid-stem models, and a dough testing dial thermometer. In addition there will be pressure recorders and gauges.

Brooks & Walker Ltd. are to show a representative selection from an extensive range of **valves** of the gate, globe, bridge, stop and swing check types, in steel, iron and gunmetal. Flanges—all to British and American standards—will also be on show. Other exhibits selected from general stocks include **boiler mountings** and **pressure gauges, vernier gauges** and **micrometers, screw thread taps** and **gauges** and various engineers' tools. The *Diprolfil* power-operated hand filing machine will be on working demonstration, together with the *Derota* workshop unit.

Broom & Wade Ltd. will exhibit stationary and portable **compressors** and **pneumatic tools** for the engineering industry. The stationary compressors range from 2 to 1,000 cu. ft. f.a.d. A special exhibit in this range will be the type S.S. two-cylinder, single-stage double-acting compressor having pistons fitted with carbon rings, eliminating cylinder lubrication. Sleeve-valve portable compressors will be represented by type S.V. 398.

Copes Regulators Ltd. will exhibit **boiler feed water regulators** for all types of boilers operating from 10 p.s.i. up to the highest steam pressure in use today. The Copes regulator feeds continuously to a boiler, stabilising the water level within predetermined safe limits. The regulator will maintain a safe water level in the boiler, and correctly controls the rate of feed water flow so that maximum steaming efficiency is obtained under all load conditions. Equipment for shell-type boilers and lower-pressure water-tube boilers will be exhibited, as well as a two-element-type regulator for use on high-pressure large-capacity water-tube boilers. A further exhibit will be an S.L.W.-type governor for controlling the steam to reciprocating pumps.

Davey, Paxman & Co. Ltd. are exhibiting on a combined stand with their associates, *Ruston & Hornsby Ltd.*, a sectioned scale model of one of their standard 150-sq. ft. **rotary vacuum filters.** The filter consists primarily of a drum, divided into a number of self-contained vacuum- and pressure-type cells and covered with a suitable filtering medium. The cells are an integral part of the drum and communicate with ports in a valve head which is divided into three sections giving control of the suction and blow-



'Broomwade' type S.S. two-cylinder compressor, with pistons fitted with carbon rings.

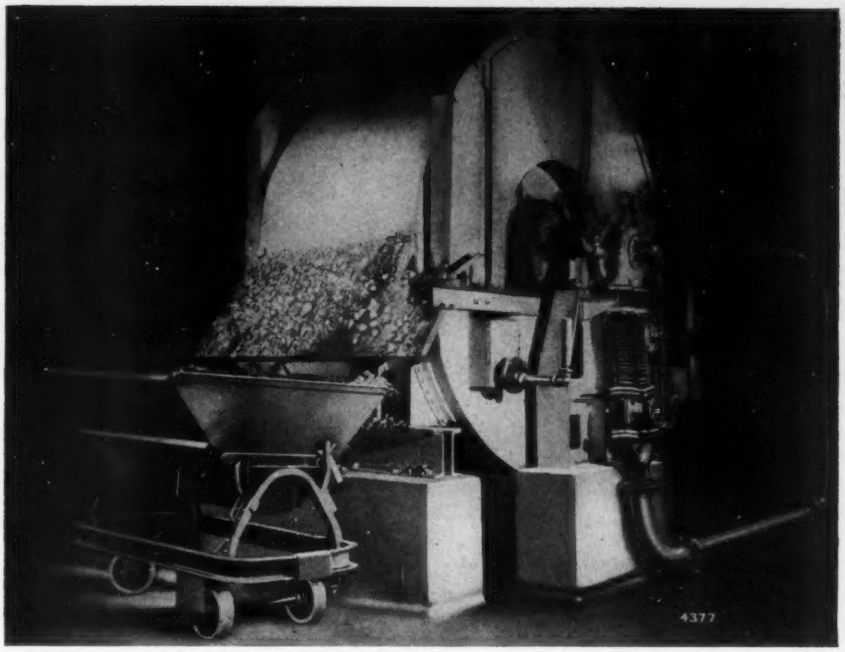
back air. The slurry to be filtered is pumped into a trough in which the drum, partially submerged, rotates at a speed of about 1 r.p.m. By the application of a vacuum to the cells, the slurry is drawn against the filtering medium, the solids remaining on the periphery of the drum, while the liquid passes through the medium into the cells and, *via* the valve head, into the filtrate receiver tank. For normal requirements, Paxman filters are usually manufactured in mild steel or cast iron construction. Where it is necessary to treat corrosive slurries, the filters can be rubber-covered where in contact with processed materials or built in stainless steel throughout.

Evershed & Vignoles Ltd. are including in their display of instruments a *Dionic* **steam purity meter.** A representative sample of steam is condensed and the meter measures its electrical conductivity, which is proportional to the quantity of inorganic salts and gases dissolved in it. The conductivity tube, indicators and recorders are almost identical with those of the *Dionic* water purity meter, but for economy's sake this particular meter is arranged to operate with a much smaller water flow. It is used in conjunction with the Evershed-Straub **degassing condenser,** which will also be on show. This removes non-condensable gases such as ammonia, carbon dioxide and hydrogen sulphide from steam or water so that a gas-free sample may be used for conductivity determination.

The **miniature recorder** which will be on view is a new instrument, mainly for use with pressure control apparatus for recording physical and other quantities which are detected by various forms of electronic transmitter. It is a moving-coil milliammeter with a small continuous-roll chart having a 2-in.-wide scale driven by a synchronous motor at a speed of $\frac{1}{2}$ in./hr. The record is made by a high-speed tapping mechanism using an inked ribbon. The overall size of the front, flush-mounted in a panel, is approximately 6 in. $\times$ 4 in.

Another new instrument to be exhibited, the **high-response recorder,** is similar to the Evershed portable recorders, but by the use of a redesigned magnetic system the torque has been increased to about eight times that of the standard recorder. The damping can be adjusted magnetically from about 54% of critical to the over-damped condition. Thus any degree of damping to suit the test in progress is at the disposal of the user.

Fraser & Fraser Ltd. are showing a **water-tube boiler** with a horizontal drum of the two-pass type. The exhibit will have the furnace casing partially removed to show salient features of the design and construction of the pressure parts and furnace. The makers say that this boiler offers all the advantages of modern water-tube boiler practice at a cost comparable with that of shell boilers.



A 100 sq. ft. rubber-lined filter, with washing gear, in a large chemical factory dealing with a highly corrosive slurry. Makers are Davey, Paxman & Co., Ltd.

Hamworthy Engineering Co. Ltd. will show starting **air compressors** for pressures up to 1,000 p.s.i. in single-, two- and three-stage designs. There will also be two-stage **air-cooled compressors** for combustion control and general service use on board ship and for numerous industrial services. Other exhibits will represent a large range of **reciprocating machines** for pressures up to 5,000 p.s.i. and displacements up to 300 cu.ft./min. There will be a display of **pumps** of the centrifugal, spindle, rotary displacement and other types, and of the R.P.O. series **rotary pumps** for non-lubricating and corrosive fluids, suitable for oil refining and chemical plant.

Incandescent Heat Co. Ltd. are including in their exhibits a model of an *Incandescent-Whiting* **twin-cupola installation** with swivel charging mechanism, the plant being arranged for continuous pouring. There will also be a model of an oil-fired **bogie furnace** with *Incandescent-Laclede* suspended-arch construction for the treatment of mill rolls.

Kirk & Co. (Tubes) Ltd. will display their malleable iron **tube fittings** and mild-steel **flanges.** They will also have mild-steel fittings, **fabricated pipework** in steel, stainless steel and copper, **coils** and various forms of **flanged pipework** for the chemical industry. This company is sharing its stand with two subsidiary companies, one of which, *Samuel Russell & Co. Ltd.*, will show a selection of malleable iron **castings,** varying in weight from a few ounces to 56 lb. The other company, *Cambrian Forge & Foundry Ltd.*, will exhibit a range of **drop forgings** in mild steel, with particular emphasis on flange forgings.

Langley Alloys Ltd. are showing their *Hidurax* **aluminium bronzes,** claimed by the makers to have high strength and hardness in combination with resistance to corrosion by all kinds of waters including sea water, and many acids and chemical liquors. This material is used for marine and chemical pump casings and centrifugal pump impellers. A recent development is the manufacture of aluminium bronze in the form of hot-rolled plate for fabrication of vessels and heat exchangers. Examples will be exhibited.

Megator Pumps & Compressors Ltd., in addition to marine and mining-industry pumps, will make a feature of fixed and portable industrial **pumps** for sump pumping, dewatering and other purposes. There will also be models for the process pumping of a large variety of foods, chemicals and other products. Visitors to this stand will be able to work a demonstration pump which will show the particular features of the self-priming *Megator-Inherent*.

Metaducts Ltd. will show two or three **stainless-steel vessels** with applications in the chemical industry. They will also be showing two types of *Metastream* **flexible metallic coupling.**

Mirrlees (Engineers) Ltd. will exhibit their *Imo* **oil pump,** which is of the rotary-screw positive-displacement type and has only three moving parts. No gears are required between the screws, which

are lubricated by the liquid pumped. The pump is used extensively for handling mineral and vegetable oils at various pressures up to 2,000 lb./sq.in. over a wide range of capacities. There will be examples of this company's pumps over this range and moving models to illustrate the design and characteristics of the pump. These characteristics include a non-pulsating, non-turbulent flow.

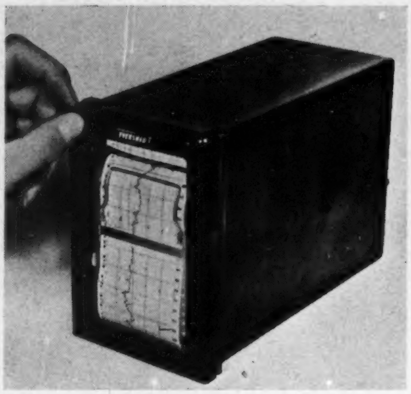
Mono Pumps Ltd. are making a feature of their *DM12* **pump** for handling powdered dry materials. This pump, recently developed, is being exhibited for the first time. Its ability will be demonstrated on the stand by drawing powder from a hopper and lifting the material back to the hopper. Other pumps included in the display are the *D* and *H* type pumps for handling free-flowing, viscous, corrosive or abrasive fluids. One pump on the stand will be shown handling a particularly viscous mixture to demonstrate its self-priming and suction capabilities. Also exhibited will be a small stainless-steel pump with a capacity of 60 gal./hr. for laboratory use or for small batch production.

Newman, Hender & Co. Ltd. will be showing a general range of **valves** and **fittings** for the control of steam, air, water, oil and gas. Items of special interest will be glandless lubricated **plug valves,** bronze **globe steam valves** and automatic-lubrication conduit **gate valves.** In addition there will be an oil well **Christmas tree** equipped with *Newman-McEvoy* valves.

Opperman Gears Ltd. are exhibiting horizontal and vertical co-axial helical and spur geared **motors** and **speed reducers.** The units provide a selection of power outputs between $\frac{1}{8}$ and 20 h.p., with speeds between 377 r.p.m. and 11 r.p.m. Single- and double-reduction worm reducers will be shown as geared motors or separately mounted units. A new helical single-reduction fractional h.p. unit will also be exhibited; it has a rating of $\frac{1}{2}$ h.p. and can be fitted to any of the well-known makes of f.h.p. motors.

B. Rhodes & Son Ltd. are making a special feature of their chemical **sight flow indicators** and *Sergeant* **oil-sealed safety valves.** The flow indicators can be supplied with bodies made in a variety of metals, either in 90° angle pattern, straight-through pattern, or in a 90° angle 'three-view' pattern, which has a third glass on top through which the liquid is observed conveniently when the indicator is fitted near floor level.

Saunders Valve Co. Ltd., in addition to their standard types *A* and *K* valves, will show a new **valve** with body, bonnet and handwheel all of *Ebonite*. This is additional to the existing *Ebonite*-bodied valve which has been available with cast iron and other bonnet assemblies, and is offered for duty



The new 'miniature recorder' to be exhibited by Evershed & Vignoles Ltd. is for use with pressure control apparatus for recording physical and other quantities which are detected by various forms of electronic transmitter.

in acid-laden atmospheres or wherever a completely non-corrosive valve is preferred. It is made in five sizes from $\frac{1}{2}$ to 2 in. The Saunders *M* **cock,** another exhibit, is a quick-action unit evolved from the aero cock used in aircraft. It has a bore of pipeline equivalent and is supplied with screwed, flanged or bib end connections for three sizes: $\frac{1}{2}$, $\frac{3}{4}$ and 1 in. A spherical plug rotates through 90° between flexible rubber seats which tighten their pressure as the pipeline pressure increases. A flexible spindle diaphragm uniting moving spindle with fixed body prevents leakage to atmosphere *via* the spindle. Among other duties it has been found suitable with viscous liquids, including gum arabic, colloids and slurries.

Sharples Centrifuges Ltd. will feature their *Vaporseal* **clarifier,** incorporating special vapour-sealed discharge covers which enable lacquers and other finishes containing inflammable solvents to be safely clarified. A **portable oil purifier** will be shown, being a self-contained unit incorporating Sharples open-type super-centrifuge, suction and discharge pumps, and electric oil heater, all mounted on a wheeled truck complete with all necessary pipework and wiring to a control panel. The user has merely to connect up to the nearest power point and couple the feed and delivery hoses to the oil tank or sump. Two open-type laboratory **super-centrifuges** will be shown, one with electric motor and the other with turbine drive, suitable for either steam or compressed air. There will also be a **solid basket centrifugal** for handling continuously any suspension of fine crystals or amorphous solids in a liquid. Among the **marine oil purifiers** shown will be a model incorporating a new 'one-pass' bowl enabling the purification and clarification of heavy fuel and boiler oils to be accomplished in a single stage by one machine, and this will be fitted with suction and discharge pumps gear-driven from the motor.

John Thompson (Dudley) Ltd. will show models of the types of plant they supply. These include a **rotary pickling plant** for pickling hot-rolled coiled strip of all sizes up to 24 in. wide. Specially designed cages, one-third immersed in the acid solution, rotate on a horizontal axis with the vertically loaded coils rotating on the inside perimeter of the moving cages. As the cage is rotated in the direction contrary to the windings of the coils, the coils open strand by strand extending to the full diameter of the cage, which is approximately one-third larger than the diameter of the coil. It has been found advisable, under certain conditions, to reverse the rotation of the cage from time to time in the pickle bath, so that the coil windings do not bind together in their expanded condition and so prevent efficient pickling. From the pickle tank, the coils are transferred to the water rinse tank, where rotation again takes place, and thence to the soluble oil bath where the final recoiling takes place.

Another model will represent an **acid recovery plant** for waste sulphuric acid pickle liquor. The acid from the pickle tanks is processed to remove the iron in the form of copperas, and returned to storage for re-use. Acid storage tanks, pickling baths, and plant for coiled-rod pickling, acid neutralisation, continuous wire pickling and galvanising, will be among other items.

Ronald Trist & Co. Ltd. will exhibit **liquid-level control equipment.** There will be shown the *Mobrey* magnetic level switches, now available for a wide range of applications in most liquids, being used as pump controls and as high- or low-level alarm units. Three models have recently been developed specially for the chemical industry, being made in F.M.B. quality stainless steel for use in corrosive liquids.

Williams & James (Engineers) Ltd. will have a display unit showing the operation of their **air pressure regulators.** Another display unit will introduce the *Pneumerstat*, a new instrument combining the duties of a pressure-reducing valve, flow-control valve and bubbler chamber. This was described in CHEMICAL & PROCESS ENGINEERING, July 1953. The third display unit on this stand will show the operation of W. & J. starter motors, and there will also be a selection from a range of automatic **air compressor plants** designed for the instrument industry, including the 'oil-free' compressor introduced at the previous exhibition.

Worthington-Simpson Ltd. are to exhibit a wide range of self-priming and non-self-priming centrifugal **pumps** of *Monobloc* construction, in which the pump and motor are combined as a single unit. There will also be split-casing, end-suction and multi-stage centrifugal pumps arranged for electric motor or engine drive.

MODERN TECHNIQUES IN

Non-Ferrous Ore Dressing

Remarkable progress has been made in the technique of ore dressing in recent years. The enormously increased demand for non-ferrous metals has necessitated the use of less rich and more complex ores, while the discovery and industrial utilisation of metals which had not previously been isolated has directed the attention of research workers to the treatment of new and often very complex ores in which they were contained. Since a large part of ore dressing is a recent science, coming into being at a time when the United States was in the van of technical progress, American techniques are naturally of great interest to the European industry. It was for this reason that under the auspices of the Organisation for European Economic Co-operation and the Economic Co-operative Association, a technical assistance mission of European experts visited the U.S. recently. Here are extracts from their report.*

THE object of the mission was to enable the experts of various nationalities to study different aspects of the industry in the U.S. and make comparisons with practice in their own countries. This was of particular value in that the experts represented many different branches of this industry which covers an unusually wide range of processes. About 60 mills were visited, and these included most of the larger non-ferrous metal treatment plants in the U.S. and Canada.

The observations of the mission may be summarised as follows:

Equipment and maintenance

Saving of manpower is impossible unless freedom from breakdowns is assured. This consideration leads the American industrialist to invest a great deal more capital in equipment than in buildings. The equipment is thus always of first-rate quality and designed with ample reserves of capacity and power. The rudimentary appearance of the buildings, which are of a severely functional nature, illustrate well the American outlook in this respect.

Although there is a universal readiness to pay the fair price for a good machine, it must be remembered that wherever possible the machine, although a good one, will have been mass-produced. Here, as in all things, the American does not consider the additional expenditure on the installation and operation of specially designed machinery to be worthwhile.

The concomitant of high-quality equipment is careful maintenance, the importance of which in the American view is shown by the size and staff of the repair shop. Wherever possible, maintenance is *preventive* and consists of the periodic replacement of parts subjected to wear.

Grinding and classifying

Many plants use grinding machinery which has been in service for many years. For relatively coarse grinding prior to gravity concentration, the usual method was seen, namely a rod mill in open or in closed circuit with screens.

For fine grinding there has been a tendency for some time towards a two-stage arrangement so that in each mill the size of the balls can be adapted to the size of the ore. A current trend is to use a primary rod mill in open circuit, followed by a secondary ball mill in closed circuit with a classifier.

In classification, the *Hydroscillator* is probably the most important innovation owing to the increased efficiency of the separation obtained in comparison with the results given by mechanical classifiers of the normal type. Developed by the Tennessee Copper Co. and the Dorr Co., the *Hydroscillator* is a hydro-separator with a rising flow of water in which the outflow is not too diluted and may therefore be used as the flotation feed.

For classification between about 10 and 100 mesh, the Fahrenwald classifier appeared to give the best separations. Similar machines, developed by the Dorr Co., have a well-designed automatic regulation based on the density of the pulp in each cell of the classifier and are widely used. There are many mills in Europe where this type of apparatus could usefully replace the very simple but inaccurate hydro-classifiers which are in common use.

Screening

The most interesting screening equipment seen was the Allis-Chalmers low-head screen with double out-of-balance drive. This is employed for either wet or dry fine screening and is tending to replace other types of screen down to 35 mesh. (0.42 mm.).

Electrically-heated screen cloths to avoid blinding of the screens by damp materials are being developed.

Another feature noted was the use of 'repulping pockets' on the surface of the screen. The bottoms of these pockets are without holes and jets of water provided immediately above them, so that ore is diluted and reconverted to pulp. This results in better washing and possibly screening, whilst the life of the screens is increased by 25%.

De-sliming

The use of the Dutch State Mines cyclone is being widely developed in the U.S. It has attractive possibilities for ultra-fine classification, and especially for de-sliming; in this connection a visit to the cyclone de-sliming plant of the American Cyanamid Co.'s Sydney mine proved very instructive. Here ten 48-in. (170-cm.) cyclones de-slime at about 200 mesh some 1,000 cu.ft./min. of pulp with 15 to 20% solid content. The use of cyclones in place of conventional hydro-separators has enabled the volume of water in circulation to be considerably reduced, as the cyclone may be fed at a much higher concentration of solids. The overflow of the Sydney cyclones contains about $6\frac{1}{2}\%$ solids, whereas, in the normal type of hydro-separator, it is about $1\frac{1}{2}\%$ for similar separation. Again at the Tahawus plant of the National Lead Co. a 20-micron split is made using 12-in. cyclones, each handling 350 gal./min. Feed pressure is 50 p.s.i., the feed carrying 5% solids, and the underflow contains as much as 65% solids.

Pneumatic tables

The use of pneumatic tables for concentration where water is not readily available or when it is desired to avoid wetting the product is being studied in the U.S. Installations of a similar kind exist in Europe and it would seem that this method of concentration could with advantage be used more widely, especially for the final concentration of alluvial tin ores after drying and before magnetic separation.

Unfortunately none of the plants visited was using this type of concentration and the mission saw only one demonstration of its operation. This was staged by the Separation Engineering Corporation, using a Sutton, Steele & Steele air-float table and treating a cassiterite-bearing pagmatite from Alabama. The separation in this case was easy and could have been made by any gravity method, but it demonstrated the action of the machine very effectively.

Pneumatic tables have decided advantages where dry grinding can be used or where the feed is already dry. They have a high throughput and, as no water is required, they have that additional advantage where water is scarce.

**Non-Ferrous Ore Dressing in the U.S*, O.E.E.C. Paris, 1953. Pp. 209.

In the U.S., pneumatic tables appear to be used principally in the chemical engineering industry, but on the alluvial tin fields of Nigeria they are employed in the final cleaning stages of concentrate containing magnetic cassiterite and columbite discarded from magnetic separators, as well as for the cleaning of any heavy sand from cassiterite where it is desired to avoid wetting the material.

In a demonstration of the treatment of a micaceous ore, dust seemed a serious problem and indicated the necessity for efficient dust collection for treatment of similar material, or of coal, for the treatment of which pneumatic tables are still used in Europe.

Pneumatic tables, suitable for treating metalliferous ores and using a porous metal deck, are made in the United Kingdom.

Humphreys spirals

This type of apparatus is fairly common and could probably with advantage be brought into more general use following two improvements which have been made, namely the use of a coating of rubber to protect the spirals against the abrasive effect of certain sands, and the use of the 'coat-hanger' for transferring water from the outer rim of the spiral to the inner rim where washing water is circulated.

Flotation

In the dressing of copper ores, a combined process of precipitation after washing and flotation, to be used shortly in a new project, is a departure from conventional methods which will be followed with interest.

An interesting feature in the flotation of fine mica is the use of sodium resinate with lime to keep the *p*H steady at 9, thereby avoiding the use of cationic reagents. In the application of reagents, a tendency was noted to replace pine oil and cresylic acid by frothing agents derived from synthetic alcohol.

Electrostatic separation

Research carried out by the Bureau of Mines in the U.S. has resulted, on an industrial scale, in excellent separations, especially in the Florida ilmenite deposits. The machines which have been developed are now being used in the alluvial tin deposits of Nigeria, and this method could profitably be applied to the separation of alluvial ores such as monazite, zircon and ilmenite in connection with alluvial tin concentration.

Filtration

A novel feature seen was the use of two beaters each comprising two flails made from two-ply sheet rubber. The flails revolve at 90 r.p.m. and are arranged symmetrically around the centre line and near the top of the drum. A fixed rubber apron protects the filter cake from the scuffing action of the beaters. A reduction in moisture of between 1 and $1\frac{1}{2}\%$ has resulted from the use of this mechanism for filtering very fine materials (containing 30%—1,000 mesh).

General conclusions

The members of the mission were continuously on the lookout for those techniques which were more advanced in the U.S. than in Europe, and the experience gained in their journey showed that there is no simple answer. There are as many differing solutions to the problems of ore dressing as there are mines differing in the composition of the run-of-mine product, the layout of the ground, climatic conditions and the class of operative personnel and the cost of supplies.

The conclusions of the mission may nevertheless be summarised as follows:

American technicians are far ahead in certain kinds of equipment, but for the greater part of machinery and plant, progress made on either side of the Atlantic is remarkably similar.

In the latter case it is necessary to make a distinction according to whether the possibilities of using the equipment are comparable or not.

Generally, the U.S. are in advance in the development of equipment for which a wide scope exists and there are four important branches in particular which come under this heading: (*a*) flotation reagents, where the Americans are in the lead and hold the majority of the important patents; (*b*) electrostatic separation, where American methods could well be adopted; (*c*) some equipment for very fine screening and wet screening; and (*d*) gyratory cone crushers for final stages of crushing.

Any reference to the material factors in which the U.S. are undoubtedly ahead should include special mention of the many consumer products necessary for the operation of any mill. These products are generally of a quality which is not only excellent but has the merit of remaining constant in each range, which considerably simplifies all kinds of operations.

In many cases, progress in the U.S. and Europe is similar as, for example, in equipment which can be used whatever the size of the plant, *i.e.* grinding, classification and flotation equipment. The ore-dressing plant in the large American firms is always made up by arranging banks of several machines of identical type which are simply used in smaller numbers in European mills.

For crushing, however, a large plant will require larger sizes of the same type as in Europe. Hence, the enormous primary crushers which give such an impressive appearance to some American plants are admirable feats of engineering, but are suitable for use only in mills dealing with large tonnages, and could not be used in some European plants.

If the various sources of energy are considered (coal, liquid fuels and electricity), it will be seen that the price per kwh. in the U.S. is lower than most of Europe. This is due to the abundant supplies of power available which give the U.S. a considerable advantage. The production of the various forms of energy, compared with the figure of total or working population and expressed in the equivalent of tons of coal, shows that every American citizen can dispose of $3\frac{1}{2}$ times as much power as the inhabitant of one of the O.E.E.C. countries; each working American has four times as much.

Hence, energy represents a much smaller cost factor than in Europe; this encourages firms to use more powerful machines, the reliability of which may cost more but without greatly affecting the operating costs of the firm.

To the low cost of liquid fuels may be added that of oils and greases which enable American firms to carry out copious lubrication at low cost. In fact, on the larger machines, the lubrication system is of striking simplicity and calls for no expensive devices. Where European designers would have provided circuits carefully designed to save lubricating oil, the Americans use a gravity lubrication feed which, in spite of a certain waste of oil, does not represent a great charge on their operating budget.

This fact has an effect on the prices of machinery, in which the provision of lubrication circuits represents a very much lower proportion of the cost, whereas for a large crusher in Europe, for example, this proportion may be as much as 4% of the price of the machine.

The human factor

The question of productivity is always present in the American's mind, as he has realised that this is the only real factor in a higher standard of living. Leaders of industry reveal this attitude by adopting a bold investment policy and giving much attention to the rational organisation of production.

However, American productivity is not only due to the policies of firms, but arises largely from the high level of professional conscience of the worker, and the importance he attaches to efficiency. It is noticeable that the American worker considers that, by working to increase the earnings of the firm which employs him, he will stand the best chance of increasing his own wage, thus defending the standard of living in which he takes a great pride.

The remaining consideration is nature itself, which seems to have been more generous in the United States. It must not be forgotten, however, that, for ore content, the American mines are far inferior to some of the mines in the overseas territories of European countries, whilst often they are no more accessible. Hard work and the willingness to take risk which has stimulated investment have alone enabled a desert like the Utah and Arizona regions to be transformed in less than 100 years into one of the most prosperous mining areas in the world.

Recommendations of mission

The mission concludes its report by advocating the adoption of the following dressing techniques:

(1) Wider use, in specific cases, of 'impact-mill' type hammer crushers for disintegration.

(2) Wider use of rod mills to take the place of the last crushing stage and provide an excellent feed for the ball mill.

(3) Improved classification by the use of the *Hydroscillator*.

(4) Use of the cyclone as classifier and de-slimer in the treatment of ores; this makes possible the dewatering of large volumes of fine material, particularly on dredges.

(5) Use of special screens instead of classifiers to separate 35-mesh particles. This process is particularly valuable in the treatment of metallic ores, particularly tin and tungsten, where excessive crushing is detrimental.

(6) Use of 're-pulping pockets' in wet screening.

(7) A more general use of dense medium separation.

(8) Industrial development of the electrostatic separation processes now currently used, particularly in the treatment of zircon, rutile and monazite ores.

(9) Use of electromagnetic feeders, for sizes up to 6 in. to 8 in. (150 mm. to 200 mm.), under storage bins.

The mission also makes the following recommendations with regard to the organisation of plants:

(1) Division of responsibility, as practised in American plant, where the 'metallurgist' is responsible for research and improvements only while the manager of the plant is responsible for production only. This division seems effective and merits consideration.

(2) More space between the different pieces of equipment and adoption of light structures so that installations may be easier remodelled in case of changes in the flowsheet or extensions of the plant.

(3) More general use of measurement and control equipment, the latter being eventually automatic.

(4) Development of custom-milling plants.

In this way small mines might be encouraged to resume operations and government subsidies could be used to promote the resumption of mining activity, even in small localities.

Acetylene from Hydrocarbons—a New Process

PRODUCTION of acetylene from hydrocarbon stocks is taking the place of the traditional calcium carbide method. Of prime importance among these new hydrocarbon conversion processes is the Wulff process, described in a recent issue of *World Petroleum*. According to this journal, the Wulff process has been in operation for over two years in the Los Angeles plant of the Wulff Process Co., which produces bottled acetylene for welding.

In common with the other new processes, the Wulff process depends on the use of hydrocarbon feed stocks in high-temperature pyrolytic operations. The high temperatures required for the hydrocarbon conversion step are achieved by a regenerative technique in suitable refractory equipment. The process yields a cracked gas containing the acetylene diluted with various other reaction products. Chemical-synthesis-grade acetylene may be separated and purified from this cracked gas by any of several well-known methods.

The Wulff process does not require an oxygen plant for its operation, as does the partial combustion process, nor does it require a large supply of electric power, like carbide or arc-generated acetylene. In addition, cracked gas from the Wulff process is undiluted by products of combustion. The high degree of thermal economy of the Wulff process is achieved by using regenerative furnaces which operate alternately on heating and cracking operations. The resultant combustion and cracked gases are removed separately. The heat stored in the refractory during the heating step is removed by pyrolysis of the feed gas and is restored by the combustion of fuel and preheated air.

The Wulff regenerative furnace consists essentially of a steel box with a bolted cover, lined with insulating and fire-brick, and, except for a central combustion space and fuel gas injection slots, is filled with high-temperature refractory 'checkers' of special design. Fuel gas burners are located on each side of the combustion section, these being used alternately, depending upon the direction of flow of heating gas within the furnace. Plenum chambers fitted with gas distribution devices are provided at the ends of the furnace to facilitate the introduction and removal of the various gas streams.

Continuous output of cracked gas is achieved by installing Wulff furnaces in pairs. The furnace operates on a four-part cycle, the complete sequence consisting of a pyrolysis step and a heating step in one direction, followed by a pyrolysis step and a heating step in the reverse direction of the gas flow. Each step is of approximately 1 min. duration, making the total cycle time about 4 min. Control of these operations is obtained by a cycle-timer operating interlocked with four-way plug-type switch valves.

Air is drawn into the furnace which is on the heating step of the cycle, for combustion in its centre section with the fuel gas admitted to the upstream burners. The products of combustion leaving the furnace are cooled, sent to the combustion-gas vacuum pump and discharged to a stack.

For the cracking operation in the other furnace, the hydrocarbon charging stock diluted with steam is admitted to the furnace countercurrent to the preceding flow of heating gases. The cracked gas from the furnace passes to a quenching system for condensation of most of the dilution steam and the small amount of liquid products and tars formed during pyrolysis. The remaining gas is compressed to atmospheric pressure in the cracked-gas vacuum pump, cooled, and flows through a knock-out drum and an electrostatic precipitator to the cracked-gas holder.

Short pyrolysis residence time favours high yields of acetylene, which undergoes rapid decomposition in the temperature range required for its formation. By operating the Wulff furnace under vacuum and in the presence of dilution steam, gas residence time in the reaction section of a Wulff furnace is in the order of 0.03 sec.

Any conveniently vaporisable hydrocarbon or hydrocarbon mixture may be used as charge stock. The flexibility is accomplished by control of the temperature pattern within the furnace.

In most applications it will be found advantageous to return unconverted hydrocarbons and by-product materials to the pyrolysis step to increase the ultimate yield. The recovery unit is accordingly designed to supply a recycle stream which is fed to the furnaces together with the fresh feed and the dilution steam.

Fabricating pressure vessels. Before 1939 practically all requirements of the petroleum industry throughout the world were met by the U.S. Since 1945, however, British firms have made increasing efforts to compete in this expanding market, with the result that during 1951 a total of £61,754,500 worth of oil-refining equipment was exported from Britain. G. A. Harvey & Co. (London) Ltd. foresaw these developments and in 1945 the first bay of a new fusion-welding shop was opened which could deal with this class of work. Shortly afterwards the firm was placed on the list of approved manufacturers to the American API/ASME code, and has since been able to compete on an equal footing with the American oil-refinery equipment makers.

In 1951 the fusion-welding shop was finally completed, and it is now one of the largest and best equipped works of its kind in existence. The company have recently published an illustrated booklet in which they review the plant and layout of this new shop, referring briefly to the older heavy-plate shop and conclude with a section dealing with recent developments in the manufacture and design of pressure vessels and other plant.

CATALYSIS

Metal systems as hydrogenation catalysts

By S. L. Martin, M.Sc., F.R.I.C.

Introduction

METALS, either in the elemental form in massive or finely-divided state or dispersed on supporting media, have long been used as catalysts for a variety of reactions of which hydrogenation processes represent important industrial examples. The work of Sabatier in the early part of this century promoted the wide-scale application of elemental metals to the industrial hydrogenation of fats and oils. Concurrent development of the contact process for the manufacture of sulphuric acid and the use of iron and platinum in ammonia synthesis and oxidation were added incentives for investigations on metals as catalysts in general. Up to the beginning of the last war such investigations, though widespread and in many cases detailed, had provided only a mass of semi-empirical and uncorrelated data with but a few hints regarding the true nature of the action of metals in heterogeneous catalysis. This was in large part because of the imperfect knowledge of the structure of metals and solids in general, and the delayed realisation of the importance of the 'electronic factor' in their catalytic reactions.

Within the last ten years the amount of metals used in industry as catalysts has increased tremendously, both because of new developments, such as the hydrogenation of carbon monoxide to give synthetic fuels or the production of hydrogen from natural gas, and of increases in plant capacity for known processes. Arnold[1] estimates that in the U.S.A. today 80% of the capacity for synthetic ammonia will be in 13 plants obtaining hydrogen by the natural gas-steam reaction over nickel catalysts and that, as a result, more hydrogen would soon be manufactured by this process than by all others combined; about 400,000 lb. of nickel catalysts per year would be required to keep present processes going, representing an annual consumption (loss of catalyst) of 80,000 lb. annually. Up to 7 tons single charges of reduced iron oxide catalysts are used in plants for the hydrogenation of carbon monoxide.[2] Bailey[1] estimates that for the hydrogenation of fats and oils using 0.05 to 0.10% nickel catalyst on the basis of oil, 1 to 2 million lb. of nickel are used in the U.S.A., with an annual consumption (loss through contamination) of some 50% of this. Such large-scale use and 'wastage' has contributed to three definite developments, themselves interrelated, in the field of catalysts.

Firstly, whereas previous practice has been for the product manufacturer to develop and control the making of catalysts for his own concern to suit his own requirements, the metallurgical and chemical industries are now paying increased attention to the production of catalysts with specified characteristics.

Secondly, on the chemical engineering side, vigorous attention is being given to the problems of handling large amounts of sensitive, often temperature-labile, catalysts in continuously operating plants so as to maintain high activity for long periods of operation. Thus the basic problems concerned with fluidisation techniques—either of solids in beds or in the flow of solids through pipes—and with heat transfer from reactive solid masses continue to receive attention, as is indicated by the nine papers at the recent symposium on fluidisation technology.[3]

Thirdly, the increased 'wastage' refocusses attention on the factors affecting catalyst life, not only because of the relatively high cost of catalysts of certain types but also because of losses incurred in early shut-downs of continuous plant due to abnormal decreases in catalyst activity. While it has been generally known for some time that loss of activity may be due to accumulation of 'poisons' (which either retard the main reaction or promote undesirable secondary ones) or to alterations in catalyst surface area and structure, definite progress had been hampered by the lack of firm pictures of reaction mechanisms. It is still probably true that for no heterogeneous catalytic process is the reaction mechanism or kinetics known with certainty, but at present semi-empirical theory provides background for what has been called 'intelligent guess-work' or 'intuition based on knowledge.'

Besides the activity and life-time, catalysts to be suitable must give reproducible selectivity for the particular reaction, have good mechanical quality and be economic. Hoog[4] has used these five desiderata as a basis for discussing practical means for developing catalysts for specific purposes; he emphasises the ever-present need for a good deal of trial and error, and the element of surprise still awaiting workers in this field.

In the rest of this review, recent developments in the theory of catalysis by metals will be reviewed and then some recent work in selected hydrogenation processes will be discussed.

Theoretical aspects

With the emergence of reasonable theories of the solid and metallic states in the period 1935 to 1945, it became possible to attempt the development of more general theories concerning the mechanism of heterogeneous catalysis. Available were two main approaches—through a 'geometric factor' and through an 'electronic factor.' The main emphasis was on the geometric factor in terms of the size of unit cells in the metal and of the nature of active centres, both in relation to the 'fit' of adsorbed molecules on the surface.[5] Coupled with the qualitative covalent bond theory there emerged a pattern of results which could broadly be interpreted with the activated complex theory.

Concurrent work on electron emission and conduction phenomena—especially in relation to adsorption processes[6, 7]—and on free radical or free ion mechanisms in homogeneous catalysis, coupled with extensions in the theory of metals,[7, 8, 9] has since re-focussed attention on the importance of the electronic factor. This has been most forcibly demonstrated in the work of Reynolds and Dowden,[1, 10, 11] Eley[10] and Schwab.[10] Following Dowden, the catalyst crystallite can be regarded as an electron 'sink' which in the presence of hydrogen-containing materials can also act as a potential proton reservoir. Electronic characteristics of metal systems, especially magnetic and electrical properties, are therefore useful practical guides for correlation with catalytic activity. The catalytic problem falls naturally into three parts:

(1) Description of the active regions on the metal.
(2) Description of the chemisorbed particles.
(3) Interactions of the group of particles plus regions.

Modern theory of metals in relation to the catalytic problem

Active catalysts are all elements which, on the periodic classification according to atomic numbers, are characterised by the

fact that an ' inner ' d-sub-shell of electrons are partly or fully occupied—in the wider sense of the term, the transitional elements, which go to make up the long periods.

There are two current approaches to a unified theory of metals. The first is the band theory,[7, 8] based on quantum statistical treatment, the second Pauling's resonating valence bond theory based on hybridisation of atomic electron orbitals[12]; these theories, which bear the same relation one to another as do the molecular orbital and the directed valence bond theories of valency in compounds, have in common an emphasis on the nature and degree of filling of the electron states in the bulk metal resulting from electrons in the d-sub-shell of the atoms to explain the properties of the transitional elements.

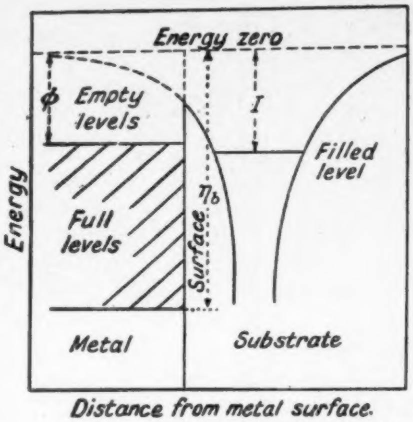
On the band theory, the properties of the solid are fixed by the electron density $n(E)$ of energy levels for the ' valence ' electrons (*i.e.* in unfilled bands) as a function of energy, and by the extent to which levels are filled or the ' height ' of the so-called Fermi-energy surface (see Fig. 1). The value of $n(E)$ at the Fermi surface is much greater for d-electron levels than for those of s or p electrons. As the number of valence electrons per atom increases, for instance from 4 in Ti to 10.6 in a Ni-Cu alloy containing 60 atom % Cu (a Cu atom with 29 electrons added to nickel with 28 total electrons per atom effectively introduces 1 more valence electron), a dense band of levels, principally the 3 d type, is being filled. Where the filling is incomplete, we may speak of ' holes ' in the d-band. The existence of unpaired electrons in holes in the d-band close to the top accounts for paramagnetism and ferromagnetism and for the relatively high electrical resistance. These unpaired or *residual valency* electrons are important in bonding substrates, for instance, by taking up an electron from a substrate molecule to form a positive ion. If the d-band becomes filled—for instance, by alloying with hydrogen or with metals such as copper which donate their s or p electrons to the d-band, paramagnetism will be zero and so will the tendency to bind substrates *via* positive ion formation. However, such a system may still be able to donate electrons for negative ion formation, and the tendency for this is reflected in the value of the electron emission work function, φ, which is simply a measure of the work required to get an electron out of the metal. On this picture, the catalytic activity will depend on the nature of substrate-bonding process controlling the reaction, and on the following properties of the metal:

(1) Value of the electron emission work function, φ.

(2) The energy density, g(E), of electrons at the Fermi surface.

(3) The sign and size of the gradient, G, of this density.

In the resonating valence bond theory, the electronic configuration of the transitional elements are considered to result



[*Courtesy: The Chemical Society*

Fig. 1. Energy of an electron in the potential field of the metal and the substrate positive ion.

from hybridisation of the five d, one s and three p orbitals of the atom to give nine strong bonding orbitals divided into three types: *atomic orbitals*, principally of d-character and responsible for magnetic properties, any unfilled ones contributing to a residual valency; *bonding orbitals*, with some d-character but containing no unpaired electrons, contributing at least in part at the surface to the bonding of substrates; and *metallic orbitals*, mainly of sp-character. The state of occupancy of the atomic orbitals thus reflects the residual valency and tendency to paramagnetism (both high at low states of occupancy). Alloying of a metal such as nickel with hydrogen or metals such as copper effectively fills these orbitals with s-electrons from the additive, leading to similar deductions as with the band theory. According to Pauling, in the series Cr to Cu, the total number of singly occupied atomic orbitals increases from 0.22 in Cr to a maximum of 3 in a 77: 23 at.% Fe-Co alloy, and falls to zero at a 40: 60 at. % Ni-Cu alloy.

Substrate-metal complexes

Again following Dowden, the ionisation potential, I (a measure of the work necessary to abstract an electron), of the substrate molecule is of importance for processes controlled by positive ion formation, and its electron affinity, A, for those controlled by negative ion formation. Pre-requisites for catalytic activity are:

(1) The free energy change of the overall process must be negative.

(2) The catalyst crystallite must possess vacant or occupied electron levels capable of accepting or donating electrons from or to the activated complex.

(3) The discrete electron levels of the adsorbate species must be such that as the atom comes near the surface the minimum ionisation potential is decreased (positive ion formation) or the maximum electron affinity increased (negative ion formation).

Positive ion formation is most favoured and fastest on metals and alloys with high work function, high positive G, and crystallising to expose planes of least density in packing. *Negative ion* formation is most favoured by a low work function and large negative G, while *covalent bond* formation is favoured by high work function, high positive G and presence of atomic orbitals in the Pauling sense.

It can thus be seen that these new theoretical approaches are by no means all-encompassing or complete, as they lead to predictions strongly dependent on the mechanism of the particular catalytic reaction concerned. However, they do point the way for sounder investigations on the nature of rate-controlling processes and, once this has been established, indicate the directions to be taken to get improved activity either by the use of new metal systems or by the exclusion of poisons or by the addition of promoters.

Poisons and promoters

Poisons may act in one of three ways:

(1) By altering the work function of the metal surface. It is well known[6] that electropositive metals such as Na and K in the adsorbed state markedly lower the work function of metals such as nickel and tungsten, while electronegative elements such as oxygen and sulphur increase it; such adsorbed layers may be expected to act as poisons where the controlling mechanism is positive ion or negative ion formation, respectively.

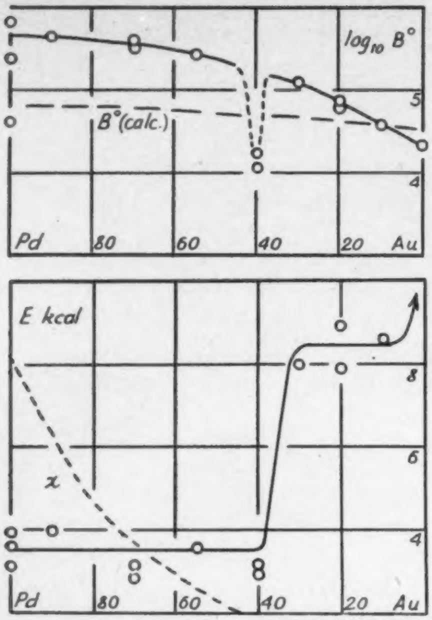
(2) By altering the density of electrons in the d-band through alloy formation, either on the surface or throughout the bulk of the metal. Thus, where positive ion formation is the rate-controlling process with a catalyst such as nickel, addition of almost any other element will lower the activity, since nickel is most sensitive—for instance, alloying with Cu or Zn and C, O, N, P, As, Sb in solid solution; the poisoning capacity may be expected to increase with the number of valence electrons available from the additive, hence the strong effect of elements such as P and As.

(3) By introducing a steric factor which inhibits the necessary relative orientation of the reacting substrate molecules or species on the metal surface.

Promoter action may be considered to proceed in entirely analogous ways, the effects being simply the reverse of the poisons. The theory thus strongly suggests that, where additives such as K and Na are known promoters, negative ion formation may be a controlling process.

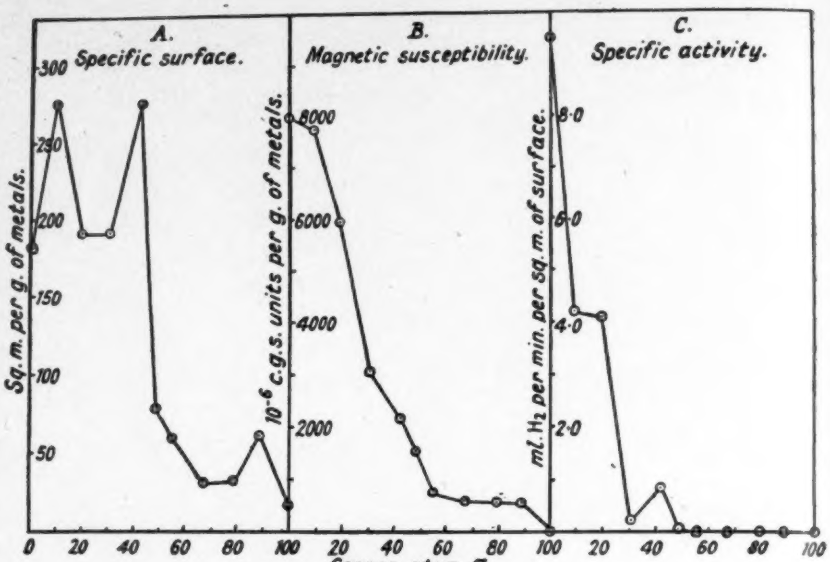
Experimental evidence in support of the theoretical ideas

Most of the present evidence is obtained from studies on alloy systems, attempting to correlate the catalytic activity for relatively simple reactions—as indicated by rates of reaction or energies of activation—with paramagnetic or electrical properties, both as functions of alloy composition and



[Courtesy: The Faraday Society

Fig. 2. Activation energy and B° as a function of composition. The broken line x denotes the paramagnetic susceptibility in arbitrary units after Vogt. (Couper and Eley[10])



[Courtesy: The Chemical Society

Fig. 3. Properties of reduced-oxide Ni-Cu alloy catalysts used for styrene hydrogenation (Reynolds[11])

where there is suitable data with calculated electron densities.

Ortho-para-hydrogen conversion on palladium alloys

Pd has about 0.6 hole per atom in the *d*-band and its paramagnetism is known to fall steadily on alloying with univalent metals such as gold or with hydrogen, becoming zero at about 60 atom % of additive. Couper and Eley[10] expressed the reaction velocity constant *k* for the first-order conversion by the general Arrhenius equation

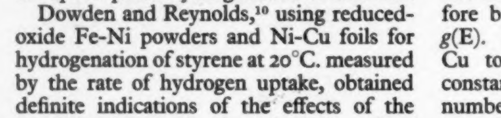
$$\log k = \log B^\circ - E/2.303\ RT$$

where R is the gas constant, T the temperature in °K., B° is the so-called frequency factor and E the energy of activation. Their results for log B° and E as functions of composition for Pd-Au alloys are shown in Fig. 2, emphasising the marked change which occurs at 60% Au in agreement with the zero point in paramagnetism (dotted curve, lower figure); they favour a mechanism involving the holding of a hydrogen atom by atomic *d*-orbital, followed by the formation with a gaseous hydrogen molecule of a H_3 activated complex held by a metal hybrid bond and by a *d*-bond, and a desorbtion of the new H_2 molecule containing the original adsorbed atom.

Hydrogenation of styrene by Ni-Fe and Ni-Cu alloys

Reynolds[11] obtained the results shown in Fig. 3 for Ni-Cu catalysts (prepared by reducing mixed oxides) in the hydrogenation of styrene in methanol at 30°C. That the correlation between specific activity and magnetic susceptibility as functions of composition is not due solely to changes in surface area is apparent. Similar correlations were also obtained for alloys of the Raney or foraminate type in liquid and in vapour-phase hydrogenation of benzene.

Dowden and Reynolds,[10] using reduced-oxide Fe-Ni powders and Ni-Cu foils for hydrogenation of styrene at 20°C. measured by the rate of hydrogen uptake, obtained definite indications of the effects of the number of holes in the 3*d*-band[8] and of the variation of electron density level *g*(E) (taken as proportional to the coefficient of the electronic specific heat term as calculated from measurements of Keesom and Kurrelmeyer), which agreed with the predictions of the theory. Fig. 4 shows that, starting with pure Fe and increasing the Ni content, the number of holes per atom falls fairly steadily from about 2.2 with Fe to 0.6 with pure Ni, but that *g*(E) remains constant up to about 75% Ni then rises sharply to pure Ni. The sharp rise in activity from 75% Ni must therefore be ascribed to the great increase in *g*(E). On the other hand, for addition of Cu to Ni, *g*(E) remains approximately constant up to 60% Cu, whereas the number of holes per atom falls steadily to zero, indicating that the decline in activity is due both to a decrease in *g*(E) and disapperance of holes in the *d*-band. This behaviour strongly suggests a controlling mechanism involving transfer of an electron to the metal from the substrate. Entirely analogous results were obtained for the decompositions of methyl alcohol and of formic acid vapours over Ni-Cu foils, the decrease in activity as the *d*-band holes fill up supporting the reaction mechanisms involving electron transfer from substrate to metal.



[Courtesy: The Faraday Society

Fig. 4. Effect of nickel content on the rate of hydrogenation of styrene by alloy catalysts.
Curve A: Ni-Fe catalysts, H_2 uptake cm.³ min.⁻¹ cm.⁻², × 10⁴.
Curve B: Ni-Cu catalysts, H_2 uptake cm.³ min.⁻¹ cm.⁻², × 10⁴.
Curve C: Number of holes per atom in the 3*d* band.
Curve D: Coefficient of the electronic specific heat term; × 10³, cal. mole⁻¹ deg. ⁻².

Finally, these authors tested the prediction that emptying of the *d*-band should decrease the activity where electron transfer from metal to substrate is the controlling mechanism, as is believed to be the case for the decomposition of hydrogen peroxide over metal catalysts. In agreement with this, the rate of decomposition as measured by the oxygen evolution was found to decrease from pure Cu to Cu with 30 atom % Ni by factors of 2 to 2.5 at 80 to 60°C.

Practical industrial significance

Most industrial hydrogenations

(Concluded on page 255)

New Trends in Fertiliser Manufacture in the United States

By Harry A. Curtis*

The steady rise in the demand for fertilisers in the United States has created many technological changes in the industry. Synthetic ammonia is now produced cheaply and ammonium nitrate has become a widely used fertiliser. The manufacture of concentrated superphosphate has been stimulated partly by the demand for uranium which is recovered as a by-product from rock phosphate processing. Following the sulphur shortage, processes in which nitric acid replaces part or all of the sulphuric or phosphoric acid used in making superphosphate are attracting wide interest. Finally, there has been a rapid expansion of elemental phosphorus production by the electric furnace method.

THE fertiliser industry in the United States is at present undergoing a rapid and rather extensive change, both with respect to its products and its company membership. The old fertiliser industry, which for so many decades expanded by just doing the same thing on a somewhat bigger scale, is now undergoing a big face-lifting operation, and when the operation is finished it will have quite a new appearance.

As industries go, the fertiliser industry has grown slowly in the past 100 years. Early in its development the industry took on certain characteristics that persisted almost unchanged for many decades. The general pattern of organisation and operation that prevailed for a long time was about as follows: Raw phosphate was mined and beneficiated near the deposits in Tennessee and Florida by several of the larger fertiliser companies. There were never more than a few independent mining concerns, but the mining divisions or subsidiaries of the large fertiliser companies furnished not only the washed phosphate used by their parent companies but also offered phosphate for sale on the open market.

With minor exceptions, superphosphate was, until recent decades, the only fertiliser ingredient manufactured by fertiliser companies. A majority of the large superphosphate producers manufactured the sulphuric acid they used, but many more concerns, in general the smaller companies, purchased both rock phosphate and sulphuric acid in the open market. A large segment of the industry, the so-called 'dry mixers,' bought superphosphate from the big producers. Most of the fertiliser used in the United States is 'mixed fertiliser,' containing various proportions of nitrogen, phosphorus, and potassium compounds. Nearly all the fertiliser companies, big and little alike, bought the needed nitrogenous and potassic ingredients of mixed fertiliser.

Aside from mining by a few companies, and superphosphate production by a considerable number of concerns, the main business of the hundreds of companies comprising the industry was the compounding and sale of hundreds of mixtures of fertiliser ingredients.

Such was, until recent decades, the make-up of the fertiliser industry in the United States. Some of the practices adopted by the industry were certainly inimical to its own interests; some led to prosecution by the Federal Government under anti-monopoly laws; and some of the practices certainly did not serve the interest of the farmer in getting cheaper fertilisers.

Table I. U.S. Fertiliser Production 1940-55 (real and estimated)

Year	Total fertilisers (tons)	N (tons)	Available P_2O_5 (tons)	K_2O (tons)	Total plant nutrient (tons)
1940	8,656,000	419,000	912,000	435,000	1,766,000
1950-51	20,989,000	1,238,000	2,110,000	1,380,000	4,728,000
1951-52 (est.)	—	1,375,000	2,100,000	1,515,000	4,990,000
USDA goals for 1954-55	—	2,185,000	3,350,000	2,100,000	7,635,000

The industry takes pride, justifiably so, in the fact that, whereas it once produced ordinary superphosphate carrying less than 14% available P_2O_5 equivalent,† today most of the ordinary superphosphate made carries 18 to 20% available P_2O_5 equivalent. Also the industry takes credit, not wholly due it, for the fact that, whereas mixed fertilisers once carried, say, only 12 to 14% total N, K_2O and P_2O_5 equivalent, today the total so-called plant nutrient content in mixed fertiliser is more apt to be in excess of 20%, and the old 'low-analysis' mixtures have disappeared from the market. It is also true that the retail price index on fertilisers has increased less than on most other supplies that the farmer buys. All these facts are to the good, but the present discussion is concerned with more basic and significant changes than these.

Recent improvements

The changes that have come about in the industry in the recent past, and are now going forward at a greatly accelerated rate, can be ascribed to several situations, among which the following may be cited.

There is a rapidly growing demand for fertilisers. This is due in part to the relatively high prices of farm products, but other factors are also influencing demand. The educational programme in fertiliser use in well-managed farm systems, promoted by such agencies as the U.S. Department of Agriculture, the Tennessee Valley Authority, the farm co-operatives, and the more progressive companies of the fertiliser industry, have been effective in demonstrating the value and role of fertilisers in farm economy. Fertilisers are now being used in increasing quantities on lands and on crops not previously fertilised. Pastures that were once relatively unproductive and grazed by inferior livestock are now showing astonishingly increased returns through use of better plant species, fertiliser and better livestock.

In response to this demand the production of fertilisers is increasing rapidly. New synthetic ammonia plants, new phosphate mining and beneficiation plants, new phosphatic fertiliser plants, and new potash mines and refineries are coming into operation.

The increase in fertiliser production in the United States is illustrated in Table I. (Data from various publications. Rounded numbers used.)

It seems doubtful that the goals set by the U.S. Department of Agriculture for 1954-55 will be reached, but there will no doubt be a large increase over the current production.

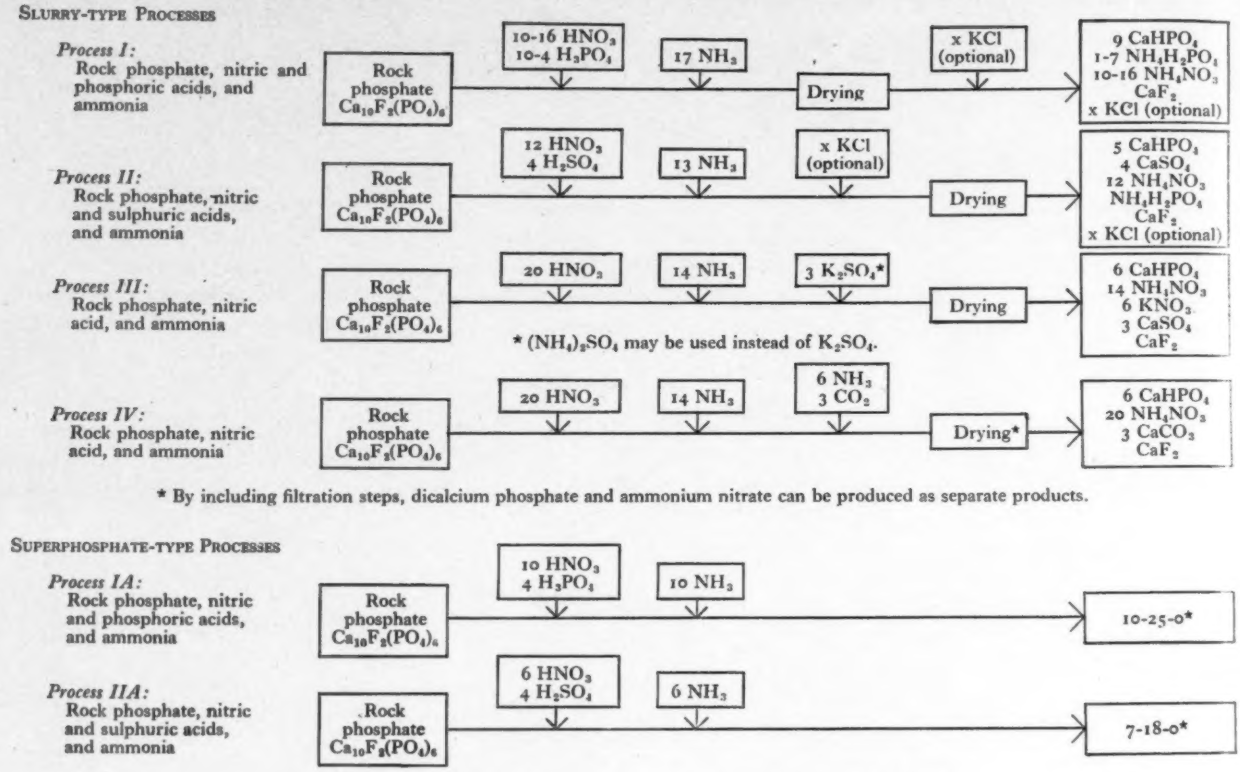
New ammonia plants

Several large companies not hitherto engaged in fertiliser production have recently built fertiliser plants. This in itself is a significant change, for most of such companies have well-organised research divisions, whereas lack of adequate research facilities was characteristic of most of the old fertiliser concerns.

*A director of the Tennessee Valley Authority.

†In the United States 'available P_2O_5' is that soluble in neutral ammonium citrate solution as determined by a procedure standardised by the Association of Official Agricultural Chemists.

Processes for production of Fertilisers from Rock Phosphate, Nitric Acid and Ammonia



* Compounds present in products have not been quantitatively determined.

Another change in the situation is related to the supply of ammonia available for fertiliser manufacturing. During World War 2 the United States contracted for the construction of more than a dozen new synthetic ammonia plants to supplement the several already in operation in this country. One of the new plants was built by the Tennessee Valley Authority, one by an oil company, one by a coal company, and all others by companies already producing chemicals of various sorts. Significantly, none of the synthetic ammonia plants in existence prior to World War 2 was owned by a fertiliser company and none of the new plants was built by a fertiliser company.

Long before the war ended it became evident that the ammonia output of the old and new plants would not all be needed for the manufacture of munitions. Ammonium nitrate had not been used to any large extent before World War 2, but, with the likelihood that large quantities of this material would be available for agricultural use after the war, both industrial concerns and the Tennessee Valley Authority turned attention to the problem of conditioning ammonium nitrate to render it more acceptable as a fertiliser. Two successful but not altogether safe procedures were developed and ammonium nitrate has become a widely used nitrogenous fertiliser. The Tennessee Valley Authority now uses a different and much safer process in its plant at Wilson Dam, Alabama, in which ammonium nitrate is crystallised from solution under vacuum.

A review of the synthetic ammonia situation near the end of the war made it appear probable that, once the demand for munitions ceased, there would be a greater ammonia production capacity than would be required by industry and agriculture for some years to come. This prediction proved to be wrong. After a short period of adjustment, all the old ammonia plants and nearly all the new ones were operating at capacity. In addition, new plants have since been built, other plants enlarged, and still others are scheduled for early construction. Significantly, one of the synthetic ammonia plants built since World War 2 is owned by farmer stockholders.

Uranium recovery

Until recently the quantity of concentrated superphosphate (46 to 50% available P_2O_5) produced by the fertiliser manufacturers was very small relative to the quantity of ordinary superphosphate (18 to 20% available P_2O_5) produced. Today, the production of the concentrated material is expanding rapidly. At least three new factors are influencing this change. First, repeated increases in freight rates have enhanced the advantages of shipping the more concentrated material. Second, farmer education with respect to the economies of using more concentrated materials has created a demand that did not exist before. (This applies not only to phosphate fertiliser but also to mixed fertiliser; the higher grades of mixed fertiliser cannot be formulated using ordinary superphosphate.) And, third, the raw rock phosphate of Florida and the western states (Idaho, Wyoming, Utah and Montana) carries small proportions of uranium. This can be recovered as a by-product in the production of concentrated superphosphate, but not when ordinary superphosphate is made. The U.S. Atomic Energy Commission is therefore encouraging the use of the process that permits uranium recovery. In 1935, about 7% of the available P_2O_5 in superphosphates was contained in the concentrated superphosphate. By 1950 the percentage had increased to about 15, and this trend continues.

Repercussions of the sulphur shortage

Another potent factor in changing the fertiliser situation was the current scarcity of sulphur. This shortage seems to have struck suddenly and with unfortunate effects, but the fact is that sulphur production has lagged behind demand and, in retrospect, it seems that everyone should have seen the storm before it struck. At any rate, all industries using sulphuric

acid suddenly discovered, a year or so ago, that there was not enough sulphur in the market. The Federal Government added sulphur and sulphuric acid to its list of commodities to be distributed only under allocation permits.

The acute sulphur shortage was temporary in the United States and is already passing. New deposits of elemental sulphur have been discovered; recovery from natural gas has been stepped up; recovery from smelter fumes has been expanded; and a number of low-grade deposits of sulphur are being mined and processed. While sulphur or sulphuric acid from these new sources will relieve the shortage, nevertheless it seems almost certain that the prices for sulphur and sulphuric acid have advanced permanently to higher levels, thus making more attractive any process of fertiliser production that avoids or reduces the need for sulphur.

Electric furnace production of P

Another development in the situation is the rapid expansion of elemental phosphorus production by the electric furnace method. Several companies have recently built electric furnace plants. Very little of the phosphorus from this source, except that produced by the Tennessee Valley Authority, is as yet used in fertiliser production. But it seems likely that the current markets for elemental phosphorus will soon be saturated, and the producers will then turn to the less attractive outlet of fertiliser production. The current elemental phosphorus production capacity is approximately 200,000 tons p.a. and the trend is sharply upward.

'Nitraphosphate' processes

It has long been known that nitric acid could replace a part of the sulphuric acid used in making ordinary superphosphate or a part of the phosphoric acid used in making concentrated superphosphate. In the United States where, until recently, sulphuric acid was relatively cheap and abundant, there was little incentive to use nitric acid. The great expansion of synthetic ammonia production capacity incident to World War 2, with consequent lowering of the market price of anhydrous ammonia and, more recently, the shortage of sulphuric acid, have made the so-called 'nitraphosphate' processes attractive.

Three or four years ago the Tennessee Valley Authority began research and pilot-plant studies of such processes, some of which had been applied in Europe. At present, an association of farm cooperatives is building a plant to use one of these processes, and several industrial concerns are considering the construction of plants to use a nitraphosphate process. Indications are that the several variations of such processes will soon come into general use in the United States. The TVA research covers six variations of the nitraphosphate process, such as are represented chemically by the equations in the diagram.

New Books

Effluent treatment

This book is intended to be a guide for all manufacturers with an industrial waste problem.* Although much of the material concerns American conditions specifically (this is particularly true of the legal aspects of the effluent disposal), a good deal of straightforward technical information is given. The 17 chapters deal with such topics as the first steps to take in finding a solution to a waste problem and the place of the engineer or specialist, the pollutional effect of various wastes, methods of treatment, equipment, coagulants and chemicals, cost of plant and recovery of waste. Chemical manufacturers generally should find the book helpful.

Organic chemistry course

This is, in effect, a new textbook.† The earlier edition has been completely revised. The aim of the work is the same—to give a student some understanding of the fundamental principles of organic chemistry and some conception of its industrial applications. It is intended to form the basis of a one-year course and is specially designed for those students whose formal training in the subject will probably go no further.

Much new material has had to be included because of the great expansion of applied organic chemistry since the first edition appeared in 1936. This covers plastics and synthetic detergents (which were important then but have become infinitely more so), catalytic cracking, GR-S rubber, nylon, DDT, sulpha drugs and penicillin, to mention only a few developments.

Study of physical chemistry

In this book,‡ physical chemistry is considered as a method of obtaining and organising information about the phenomena of nature and of using quantitative and mathematical techniques to solve chemistry problems. The subject is presented as a way of finding out about nature rather than as a description of what has been discovered in the past. Its study is regarded as the acquisition of skill in the use of quantitative and mathematical methods in the solution of chemical problems.

The various chapters cover properties of gases, kinetic molecular theory and intermolecular forces, solutions, the first law of thermodynamics, thermochemistry, quantum principles, chemical equilibrium, rate of chemical reaction in homogeneous systems, the galvanic cell, the thermodynamic concept of free energy, interpretation of phase diagrams, electrical conduction in solutions, ionic solutions, effects of pressure and temperature on free energy and some effects involving surfaces.

Industrial Waste Treatment, by Edmund B. Besselievre. McGraw-Hill, 1952. Pp. ix + 391, including indexes. Illustrated. 59s. 6d. net.

†*Organic Chemistry*, by L. J. Desha. 2nd edition. McGraw-Hill, 1952. Pp. xvi + 595, including index. 55s. 6d. net.

‡*Introduction to the Study of Physical Chemistry*, by Louis P. Hammett, McGraw-Hill, 1952. Pp. xii + 427, including index. 51s. net.

Recent publications

'British Chemical Plant, 1953.' This directory, issued by the British Chemical Plant Manufacturers Association, is now a biennial publication, the last edition having been published in April 1951. It has three main sections: (1) a list of members with their addresses and, where they have wished to publish them, the names and addresses of their overseas agents; (2) an illustrated section consisting of members' advertisements; and (3) a classified index of products and services prefaced by advice to enquirers and followed by a key in French, German and Spanish.

As the central illustrated section is printed on white art paper and the other two sections on azure the reader is readily able to identify the three sections. The foreign language key is a new feature which adds to the usefulness of the publication.

The number of members listed in the 1953 edition is 192, there are 109 entries in the illustrated section, a total of 246 illustrated pages and 1,204 headings and sub-headings in the classified index, exclusive of cross-references. All these are increases on the 1951 directory.

A limited number of copies is available free of charge to chemical plant users, who should apply, on their trade heading, to the Secretary, B.C.P.M.A., 14 Suffolk Street, London, S.W.1.

Polystyrene. A new brochure published by Erinoid Ltd. outlines the uses and applications to which each particular grade of polystyrene is suited, and also technical properties and information to assist in manipulation. The brochure shows the colour range available for the various grades of material and also gives some instructions for the correction of various moulding faults. *Erinoid* polystyrene is made by Styrene Products Ltd.

Conveyor belts. As well as describing their range of conveyor and elevator belting, Dominion Rubber Co. Ltd. give some useful facts and formulae in a new illustrated catalogue. This is intended to be a brief guide to users of conveyor belting, setting out principles which will enable the engineer to select the belting most suitable for a particular job. Factors affecting capacity and speed are explained and there are formulae on horsepower and belt tension as well as instructions for installing, training, jointing and splicing belts.

Chemical Glassware Factory Enlarged

EXTENSIONS totalling some 25,000 sq. ft. have been completed at the Stone (Staffs) factory of Quickfit & Quartz Ltd. These extensions include a new shop devoted to production of industrial plant in glass, a new canteen and a kitchen. Other buildings in the vicinity of the factory were acquired, including an old flour mill and a printing works, which were converted for use as stores and offices, respectively.

During a recent visit to Stone we were able to see how the occupation of the new building has made possible the reorganisation of other sections of the factory, resulting in considerably increased production of both industrial plant products and *Quickfit* interchangeable laboratory glassware.

On our tour of the factory we visited the development and research department and the laboratories, which now occupy separate and more extensive premises. An independent unit has been established for production of special apparatus and equipment to customers' specifications. This latter department is engaged on unusual work which cannot conveniently be dealt with in routine production. The men engaged on this type of work function as a team instead of being accommodated in different sections throughout the factory.

Electric welding of glass

The extensions include plant for the electric welding of glass. The advantages of electric heating are its ability to heat glass rapidly and locally, and to manufacture articles in thick glass which were either extremely difficult or even impossible to obtain by other existing methods.

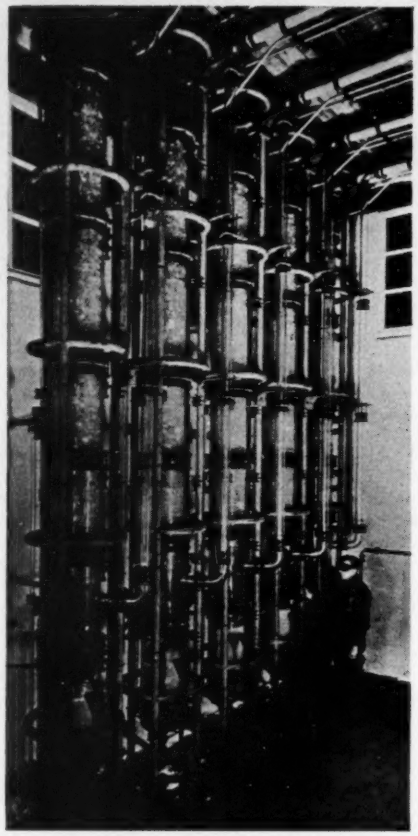
This process is based on the fact that, above a certain temperature, borosilicate glass becomes a conductor of electricity, so that electrical energy can be absorbed. The resulting heat formation rapidly raises the temperature to the point where the glass is fluid and can be worked and blown in the usual way.

A striking advantage of this process is in the heating of thick-wall section material. With oxy-coal gas heating, glass being a poor conductor of heat, it can be extremely difficult to transmit heat from the outside of a tube to the inside. With the electric heating method, the electrical energy is absorbed in depth and does not depend on heat conduction to raise the temperature throughout.

A further point in favour of electric heating is that the zone of application can be kept to a minimum. Large, powerful oxy-coal gas flames spread heat over a wide area, whereas the electric method permits localisation—a useful feature when manufacturing intricate articles.

Company's beginnings

The company, formed at King's Norton in 1934, moved to Stone in August 1946. Only six employees and two executives came from King's Norton, the rest of the labour being recruited locally. When it is realised that nearly every operation in the production of glassware demands some degree of skill and that for complicated items a five-year period of training was formerly regarded as the minimum, it will be seen that the move bristled with difficulties. However, by concentrating on only one or two simple items, production actually got under way during the first few weeks. It was not until some eighteen months later, however, that the company was in a position to manufacture at Stone either top-grade laboratory glassware or any industrial plant in glass.



A glass plant constructed overseas for production of A. & R. quality sulphuric acid.

Using newly installed plant for the electric welding of glass, these operatives at the factory are here working on the neck of a large flask.

Another problem was gas. The town of Stone could offer only 600 cu.ft./hr., whereas the factory's requirements were in the region of 6,000 cu. ft. However, in view of the importance of the company's products to the chemical industry for national research purposes and for direct export, an eight-mile 8-in. main was laid from Stafford.

Tooling up

Much of the equipment at Stone has been built to the company's design, in most cases in its own design department and tool shops. Examples are the shaping lathes used in production of conical ground-glass joints; special burners for certain jobs, which eliminate the raucous noise of the ordinary nozzle burner; and the very heavy lathes with adjustable speeds, adjustable headstock spindles and compressed air fed through the lathe head, which are used for the production of industrial plant.

The bulk of the work done at Stone is production of laboratory glassware with interchangeable conical ground-glass joints, from glass tubing and flask mouldings. The cones and socket blanks are preformed on lengths of tubing or on flasks, inspected and annealed before the grinding operations which produce the final accurate taper which ensures gas- and liquid-tight seals.

After final inspection, the finished interchangeable joints are either sent to the stores for direct re-sale or re-issued to the scientific lampworkers for assembly into the various units.

Glass plant for industry

Production of chemical plant depends upon three fundamental types of glassware: tubing for pipeline; blown mouldings for storage vessels, reaction and still vessels, fractionating columns, etc.; and glass pressings, produced in quantity to standard shapes.

Glass pipeline, for instance, may be a combination of machine-drawn tubing and glass pressing. A glass heat exchanger

may be a combination of machine-drawn tubing, blown mouldings and glass pressings. The production of these articles comes under the general heading of lampworking.

For the lampworking of larger-diameter and heavy articles the glass-blower's two hands are replaced by a butt-sealing lathe. This type of machine performs the rotating operation carried out by the bench lampworker for smaller work.

A butt-sealing lathe, therefore, has two headstocks carrying work held in suitable chucks, both headstock spindles being capable of rotation at identical speeds. One headstock is fixed and the other is capable of being moved to and fro in the common spindle axis.

The lampworker applies his bench lampworking technique to the production of larger work, being relieved only for the necessity for hand rotating of the glass. No lesser degree of skill is required to produce glassware of equivalent complexity in the lathe than is the case in handworking.

Among the products that we saw being produced were glass pipelines up to 18 in. in diameter, condensers, heat exchangers (consisting of condenser-type coil assemblies sealed into glass jackets), batch and continuous stills, and glass extractors and scrubbing towers. In the erecting shop a complete installation of glass chemical plant was being assembled for inspection and testing before delivery.

Ion exchange system for chromate recovery

The need for the prevention of stream pollution and the critical need for chromic acid has caused American industry to consider a variety of disposal methods. There is a demand for equipment to recovery chromium-containing ions from baths employed for anodising aluminium, chromium plating and copper stripping, in which processes chromic acid becomes contaminated with metallic cations.

One ion exchange method which is reported to be successful in eliminating stream pollution and returning usable chromate to the treatment tank utilises synthetic resins. The system incorporates a cation exchanger to remove metallic cations from the strong chromic acid anodising solution and an anion exchanger to recover chromate from dilute rinse solutions. Hydrogen ions are exchanged for metallic ions. The cycle is completed by using ion exchange resins for recovering chromium ions.

The anodising bath is operated at a *p*H between 0.7 and 0.9 and 50 to 70 g. litre of chromic acid. A portion of the bath is withdrawn each day and passed through the bed of a high-capacity cation exchanger. Aluminium and other metallic cations are removed from this portion and hydrogen cations are substituted. The resulting solution, having a very low *p*H, is returned and mixed with the remainder of the chrome bath, lowering the overall metallic content and *p*H.

Regeneration of resin

When the resin becomes exhausted, it is regenerated by contact with sulphuric acid. The effluent sulphuric acid, along with the metallic cations, is sent to waste. This acid is then washed from the unit with water. The chromic acid is displaced with water and this results in some desirable dilution.

A tank for the purpose of saving the rinse will conserve from 60 to 90% of the chromate being dragged from the treatment tank. However, the remaining chromate still requires treatment, and is therefore sent through the bed of an anion exchanger, which removes chromate ions and substitutes hydroxyl ions. When treating virtually pure chromic acid, this results in the formation of water in place of acid. Because the equipment also operates as a water demineraliser, the rinse tank contains demineralised water almost exclusively. Thus, when chromic acid is removed, demineralised water remains that can be returned to the rinse tank for re-use.

Costs compared

It is reported that, compared with conventional disposal methods, this system costs 50% less for initial instalment, operation costs are 75% less, about 80% less floor space is required, water and steam consumption is 85% less, better plating and anodising is obtained, and higher-quality finish products are produced.

Oil-free petroleum sulphonate

An oil-free petroleum sulphonate which is reported to facilitate chemical processing and which may have valuable usage in a variety of industrial applications where oil cannot be tolerated, has been developed by L. Sonneborn Sons Co., New York. The oil-free product, which can be produced economically by conventional methods with only one or two additional processing steps, is said to be effective as an emulsifier in emulsion polymerisations used to produce synthetic resins and rubber latices. In this connection, the product is particularly useful in the polymerisation of butadiene with either styrene, acrylonitrile or vinyls, and is highly successful in fat splitting.

Chemical Week states that production of the oil-free petroleum sulphonate starts with a drastic sulphonation of a select fraction of crude oil with concentrated sulphuric acid. During the process, two layers of solution are formed, with the upper portion containing the oil-soluble sulphonic acids and the lower layer consisting of the water-soluble acids. After the settling phase of the process, the lower layer is drawn off in order to recover the sulphuric acid portion. The upper layer is neutralised with caustic to form the sodium petroleum sulphonate. (The end product may be modified to calcium, barium, magnesium, chromium or other salt by further reaction with the suitable metallic chloride.) After complete neutralisation has been accomplished, the salt content is removed by solvent extraction. After complete removal of the salt, the solvent used in this phase of the process is disposed of through distillation, leaving the solution containing about 62% sulphonate, 33% oil and 5% water.

The final oil-free sulphonate is obtained through a second continuous extraction effected in a special kettle designed to accommodate sizable proportions of solution. After a final distillation step to remove the solvent used in the second extraction, the product is formed to contain about 50% water and 50% petroleum sulphonate. Where required, this final solution can be further concentrated to comply with the needs of the particular situation.

Catalysis

(*Concluded from page* 250)

are complex processes, which may involve more than one reaction mechanism, especially where a variety of products may result depending on the conditions. It is therefore difficult to generalise, and impossible yet to rule out the geometric factor which may in certain cases be the more important one. The well-known tendency of nickel catalysts used for hydrogenation of fats and oils to vary in selectivity with preparative conditions and with impurities in reactants is no doubt due at least in part to the pick up by the catalyst of deleterious ' alloying ' additives. It is possible that catalysts of the alloy type with activity lower, but resistance to poisoning greater, than nickel may be of better economic use, and the patent literature is beginning to indicate examples.

REFERENCES

[1] Symposium on Nickel, *Ind. Eng. Chem.*, 1952, **44**, 977, *et seq.*

[2] Kastens, Hirst and Dressler, *Ibid.*, 1952, **44**, 451.

[3] Symposium on Fluidisation Technology, *J. Applied Chem.*, 1952, S 1.

[4] Hoog, *Chem. Ind.*, 1951, 872.

[5] Griffith, ' Recent Advances in Catalysis,' Vol. 1, Academic Press Inc., New York, 1948, p. 91.

[6] de Boer, ' Electron Emission and Adsorption Phenomena,' Cambridge University Press, 1936.

[7] Seitz, ' Modern Theory of Solids,' McGraw-Hill, New York, 1940.

[8] Mott and Jones, ' Properties of Metals and Alloys,' Oxford University Press, 1936.

[9] Hume-Rothery, ' The Structure of Metals and Alloys,' Oxford University Press, 1936.

[10] ' Heterogeneous Catalysis,' *Discussions Faraday Soc.*, 1950, No. 8.

[11] Dowden, *J. Chem. Soc.*, 1950, 242; Reynolds, *Ibid.*, 1950, 265.

[12] Pauling and Ewing, *Rev. Mod. Phys.*, 1948, **20**, 112.

Plant and Equipment

Dust arrester

The problem of collecting dust from individual machines installed at appreciable distances from each other, making a composite dust-exhausting plant impracticable, is claimed to be met by the *Uniclone* dust arrester. Briefly, the machine comprises an exhausting fan beneath which is a high-efficiency cyclone and dust bin, built as a compact unit into a cylindrical casing which, if necessary, can be mounted upon a trolley to enable the exhaust to be applied to an individual operation on a range of machines, when this is of a dusty nature.

In operation, the dusty air is drawn into the machine by the centrifugal fan of paddle-blade type, fitted to the vertical shaft of an electric motor mounted on the top plate of the cylindrical casing. The dusty air then passes into the cyclone, from which the dust is deposited into the removable dust bin, enclosed by the dust-tight door at base.

The fan is fitted with a scroll and arranged to discharge through a rectangular outlet which, in accordance with the Factories Act, can, if required, be connected to a further length of piping to discharge the air exhausted to outside atmosphere.

An appreciable air volume is handled by these units which, on account of their design, can be relied upon to work continuously, according to the makers.

The design of the suction piping can be adapted to suit particular duties and machine set-ups, and many *Uniclones* are in use on double-ended and other types of grinders, opening and mixing machines, lathes, polishing buffs, etc.

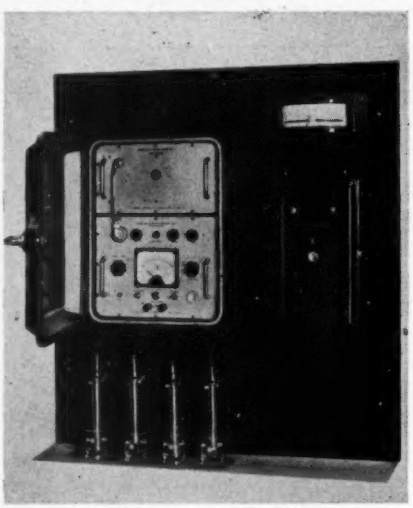
Four sizes are made—21, 27, 30 and 36 in. units—the capacity ranging between 450 cu.ft./min. in the smallest to 1,300 cu.ft./min. in the largest size. Power consumption is from $\frac{3}{4}$ h.p. to $2\frac{1}{2}$ h.p. Makers are Sturtevant Engg. Co. Ltd.

The 'Uniclone' dust arrester, for collecting dust from widely-spaced machines. The dust-tight door has been removed to show the removable bin.

Multi-electrode pH indicator

There is often a need in the chemical industry to record the *p*H values at various stages in a manufacturing process. The cost of providing a number of individual *p*H recorders for this purpose may be prohibitive and, in order to overcome the difficulty, Electronic Instruments Ltd. have introduced a self-contained electrode switching unit, the purpose of which is to enable the readings of a number of *p*H electrode systems to be registered individually on a single *p*H recorder located at some convenient point.

The electrode switching unit is designed to be used in conjunction with the model 28 industrial *p*H meter made by this firm and this, in turn, may be connected to any of the conventional multi-point recorders which are widely used in the chemical industry.



Electrode switching unit which, when used in conjunction with a single *p*H recorder, dispenses with the need for a separate *p*H indicator at each stage of the manufacturing process.

For further details of plant and equipment please use the coupon on page 266

The multi-electrode unit may be operated manually or it may be arranged to be switched automatically in synchronism with the multi-point recorder, so that each electrode system in turn is connected to the *p*H meter for the length of time required for the recorder pen to make the appropriate trace.

From one to six electrode systems may be connected to the switching unit and a separate control is provided to compensate individually for the asymmetry potential of each system. A visual indicator shows which electrode is in circuit at any given moment and a simple over-riding manual control enables any particular electrode to be selected at will.

Tube heater batteries

For many years Wellington Tube Works Ltd. has been one of the leading manufacturers of steel tubes and fittings. In addition to the production of gas list tubes and fittings, the company has paid great attention to the development of the utilisation of steel tubes for purposes other than their orthodox uses of conveying liquids and gases. This development of the fabrication side of the company's activities has been on a rapidly increasing scale in recent years.

The Weldex Heater Department of the company has developed two different types of gilled tube heater batteries. One battery (Type N) is constructed of rectangular steel gilled tube to give the greatest possible quality and strength. The other battery (Type X) is constructed of spirally wound gilled tube and is a recent introduction to meet the demand for minimum first cost in cases where flat gills are not essential. These products are but a selection from an extensive range of heaters of capacities varying from small unit heaters to heavy duty plenum and process equipment, heat exchangers and coolers.

Specific gravity tester

A new specific gravity tester (series 900) has been introduced by Solway Flowrators Ltd.

Liquid enters the bottom connection of the instrument, past a needle valve, and into the measuring chamber consisting of a parallel precision bore glass tube. It overflows through two vertical pipes and flows out through the upper connection in the bottom end fitting, thus maintaining a constant level of fluid in the measuring chamber.

A small dial thermometer immersed partly in the inlet stream, but mostly in the outlet stream, indicates the fluid temperature continuously. In the *Tufnol* model a mercury-in-glass thermometer is suspended inside the measuring chamber instead. A vent in the top end fitting can be piped to atmosphere when noxious fumes are present.

The instrument cannot be used under pressure.

An Inexpensive Soap Stock Conversion Plant

THE careful planning for maximum economy which usually accompanies large-scale plant design is not always evident in smaller plants, so that frequently the results obtained from small-scale operations are disappointing. In a paper presented to the American Oil Chemists' Society,* Mr. Herman Levin and Mr. J. S. Swearingen showed how sound engineering design has been successfully applied to one small plant which has so far given over two years of satisfactory operation; namely, a plant for the small-scale conversion of soap stock (raw foots) to a crude fatty acid product. It can produce 6 tons/day of product (90 to 95 wt. % fatty acid) from 4,000 gal. of soap stock feed (35 to 40 wt. % fatty acid).

The plant was installed at a Texas vegetable oil refinery where, in considering the disposal of their soap stock, they were faced with the dilemma that their nearest possible consumer was well beyond the maximum economic shipping distance for soap stock and, at the same time, anti-pollution regulations prevented them from discharging it through the local sewerage system. The only reasonable course, therefore, was to convert the soap stock to a marketable product in order to dispose of it. The low profit margin available made it essential that the utmost economy should be imposed in the design of the plant, but without any corresponding sacrifice in process efficiency or increased labour or maintenance costs.

Costs

The plant was installed at a cost of $11,000 and the unit investment ranges between $7 and $8 per annual ton of product. During two years of continuous operation, at varying percentages of capacity, total processing costs have averaged 75 cents/lb. of fatty acid product.

The process consists of three basic steps: (*a*) acidification or acidulation, with 66° Bé sulphuric acid, of the highly basic, diluted soap stock feed to convert the soap into free fatty acids; (*b*) breaking the emulsion of fatty acid and foreign material in water by means of heat and agitation; and (*c*) phase separation. This last consists of three parts: the recovering of the fatty acid product (top layer) and transferring it to storage; the recirculation of the middle or interphase layer for reprocessing; the removal of the bottom layer (acidified waste water), which is neutralised with caustic solution before being discharged into the sewer.

The daily operational cycle, based on an 8-hr. operating day, was decided upon as follows:

(1) Discharge and separation of settled tank contents from previous day's run (2 hr.).

(2) Soap stock charged to treatment tank (2 hr.).

(3) Soap stock preheated to 200 to 212°F. (1 hr.).

(4) Acidulation of soap stock with 66° Bé sulphuric acid, followed by air agitation to obtain intimate mixing of both phases (1 hr.).

(5) Steam cleaning of various lines carrying soap stock, recovered fatty acid and recirculation material.

It was planned to allow the treating tank contents to settle overnight before separation of the waste water and fatty acid phases.

Economic design of plant

The major items of equipment were two 12-ft. diam. × 14-ft. high (12,000-gal.) wooden treatment tanks, one 30-gal./min. gear-type transfer pump (steel), one 10,000-gal. sulphuric acid storage tank, two 25,000-gal. fatty acid product storage tanks, a caustic solution metering drum, one 4,000-gal. soap stock hold-up tank and a sulphuric acid weigh drum (acid egg). By specifying wooden treatment tanks, corrosion problems were avoided. In addition, the equivalent of conical bottoms was obtained by tilting these tanks through 2.5°. The gear-pump was for handling soap stock feed and fatty acid product only, transfer of corrosive streams being accomplished by means of air pressure or simple but effective steam ejectors made from pipe fittings.

Process control is accomplished manually, and simple metering devices ensure low cost and trouble-free operation. Of these devices the sulphuric acid metering system is a good example. A small acid egg was fabricated from 12-in. diam. black iron pipe and attached to one end of a balanced, steel beam loaded at the other end with a 100-lb. spring scale. The egg was designed to hold the anticipated acid requirement for a 4,000-gal. charge of representative soap stock. In this way the operator need only fill the egg to the desired weight and then, by pressurising the acid egg, transfer the acid up to a control valve located above the overhead platform. From here, acid may be directed into either of the two treatment tanks.

Sulphuric acid is introduced at the top of each treatment vessel in a mixing tee, where it is diluted with water. This is done to avoid locally concentrated reactions which would otherwise result in sulphation of the fatty acids and excessive foaming. The dilution water also aids in phase separation.

Neutralisation of the waste mineral acid bottom layer is also accomplished very simply. The caustic metering tank discharges into the drain at the same point as a common, external swinging joint, adjustable back-pressure head discharge line from both treatment tanks. Operational experience indicates to the operator the appropriate level at which to set this adjustable discharge line. This will allow the waste mineral acid layer to be completely discharged without loss of either the turbid interphase layer (which is recycled) or the free fatty acid layer, which is sent to product storage. A manually-adjusted, calibrated valve at the side of the caustic metering tank allows a regulated flow of neutralising caustic to be fed to the discharging waste water from the treatment tank.

Operation

Soap stock is charged into one of the two treatment tanks, and simultaneously steam is admitted to a 2-in. *Monel* heating coil in the bottom of the treatment tank to begin warming up the soap stock. Similarly live steam is admitted directly into the charge through a ½-in. *Monel* pipe. While this is taking place, the operator weighs out his sulphuric acid charge into the acid weighing tank and then pressurises the sulphuric acid system up to the control valve, as previously described. By this time the soap stock charging has been completed and he shuts off the charging pump. Still at the bottom control position he flushes the soap stock charging lines to prevent caking and solidification of this material in these lines.

He then goes to the overhead platform and begins adding the sulphuric acid with a diluting stream of fresh water, meanwhile continuing to bring the soap stock charge up to the desired temperature range of 200 to 212°F. (93 to 100°C.). By the end of the sulphuric acid addition the vessel's contents are generally up to the desired temperature range, and the live steam agitation of the charge is replaced by air. He proceeds to agitate the treatment tank contents vigorously for 30 to 60 min., depending on the soap stock feed and the requirements for breaking the emulsion. At the end of the agitation period he turns off this air and continues to circulate steam in the 2-in. circular *Monel* heating coil in the bottom of the vessel and allows the acidulated charge to begin settling.

Two points to note are (1) that completion of acidification is indicated by the materials becoming uniformly milky and (2) that less foaming is encountered with a caustic soap stock when the diluted sulphuric acid solution is added to the soap stock; however, just the reverse is true when soda ash soap stock is being treated. The reason appears to be that, in the case of the caustic soap stock, the foaming action is chiefly caused by soaps. In the case of the soda ash soap stock the problem appears to be one of liberation of CO_2 as the soap stock material is being neutralised. Consequently, in treating soda ash soap stock the diluted sulphuric acid

*Published in *J. A. Oil Chem. Soc.*, 1953, **30**, (2), 85-88.

(acidulating solution) is added to the treatment tank first and then the soap stock is charged in on top of this.

In either case, after the acidulated, blown charge has settled overnight, the waste layer is discharged, as described earlier, in conjunction with a neutralising flow from the caustic metering drum. Both streams enter an open drain leading to the sewerage system. Complete neutralisation of the waste-water layer does not require attention by the operator. By means of sample cocks at the bottom of the treating tank he can determine when he is approaching the interphase layer. This layer is recycled into the next treating tank by means of a steam jet ejector as has been described previously. A sample valve in this recycle tells the operator when to stop transferring recycle and begin sending his product over to the product storage tank. This transfer of product he accomplishes by means of the transfer pump. It will be noted that, before the transfer of product takes place, the recycle lines in the common tank discharge manifold, which may have trapped recycle material and waste water, are flushed with steam. After the fatty acid product layer has been transferred to storage, the entire transfer line is flushed with steam also. At this point the processing cycle is ready to begin over again with a charge of soap stock going to the next treatment tank, which contains the recycle from the previously treated batch just described.

New standards

Hydrometers. When first published in 1936, the British Standard for Density Hydrometers and Specific Gravity Hydrometers covered density hydrometers only, but it has now been extended to include specific gravity hydrometers in order to meet the requirements of many industrial processes. For density hydrometers the well-established standard temperature 20°C is retained, but having regard to developments in the petroleum industry, density at 15°C. is now made a permissible alternative. For specific gravity hydrometers, 60/60°F. has been chosen as the basis of scale. The relationship between these bases of scale is given in an appendix.

Nine series of hydrometers are specified in B.S. 718: 1953. The dimensions, though differing from those specified in 1936 in order to cover the bulk of existing production, have been selected so that very few different bulb volumes are required. Only the essential dimensions are mandatory, the remainder being recommended for the guidance of manufacturers. Provision is made for the hydrometer to be adjusted to one of three surface tension categories—low, medium or high—for convenience in use with different liquids. The specification also covers materials and workmanship, construction, scheme of graduation of the scale, tolerances and inscriptions.

Appendices are included on the determination of density and specific gravity, including precautions to be taken and corrections to be applied; on the measurement of liquid in bulk; on suitable vessels for hydrometer observations; on buoyancy corrections for use in relating hydrometer readings and pycnometer observations; and on the density of distilled water between 0°C. and 42°C. The standard costs 5s. from the British Standards Institution, London, S.W.1.

Solid drawn copper-silicon tubes (B.S. 1866: 1952) gives the chemical composition and mechanical properties and includes details of making the mechanical tests and a mercurous nitrate test. Tolerances on width, length and thickness are tabulated. (Price 2s.)

Sieve testing. Certain industries especially concerned with the sieving analysis of powdered materials have formulated specifications for the sieving procedure and these are incorporated in the appropriate British Standards. The recommended methods given in the new standard, 'Methods for the use of British Standard fine-mesh test sieves,' B.S. 1796:1952, are not in any way intended to supersede such specifications, but are to serve as a general guide to sieve users.

This standard gives information on the principles of sieving as well as on the equipment to be used. It then proceeds to define the method by which the sample should be prepared for the test and the weight of sample to be taken. The sections that follow deal with the removal of fine dust by both the dry and wet methods. The actual sieving procedures are subdivided into those dealing with hand sieving to the 'end point' by the rate test, machine sieving to the 'end point' by the rate test and a routine sieving test. Other sections deal with such subjects as loss of dust during sieving, sieving tests on materials with only a small weight of oversize on the sieve, and the method of reporting results and accuracy of results. Finally, appendices are included dealing with methods of sub-dividing bulk samples and some additional notes on procedure. The standard costs 3s. 6d., post free.

Improved cement kiln

A method of rotary kiln operation, using controlled heat, for producing clinker in the manufacture of Portland cement, and known as the Nagel method, appears to offer considerable advantages. Designed and patented by Theodore Nagel, New York, it is reported to increase clinker production by 15% per kiln-hr., decrease fuel consumption by 10% per barrel of clinker and to increase substantially the operating periods before renewal of kiln linings in the clinkering zone becomes necessary.

The Nagel method of combustion injects a stream of fuel into the kiln, so controlled as to produce a wide, flat, flame parallel to the surface of the clinker material flowing through the clinkering zone. In conventional methods, the injected fuel spreads out into a cylindrical flame, substantially filling the space not occupied by the clinker material, thus transferring approximately 75% of its radiant heat to the refractory lining in the clinkering zone—with consequent heavy waste of high-temperature clinkering heat.

The flame of the Nagel method, its shape controlled to a comparatively shallow flat sheet confined close to the clinker material, transfers approximately 50% of its liberated radiant heat directly to the clinkers. It also moves this heat zone forward to the kiln exit, thereby preventing annealing of the clinker within the kiln. Because more high-temperature heat is radiated to the clinker material itself, more clinker is produced per unit of fuel. This is an important factor, since the volume of cement production depends on the amount of clinker produced.

The additional plant capacity made possible by the Nagel method of kiln operation can become effective immediately without the necessity of purchasing large amounts of expensive equipment.

Correspondence

Silk and Perlon

To the Editor.

Dear Sir—In your May issue you refer to 'Perlon silk.' Such a term is unfortunately quite incorrect, since perlon and silk are different fibres and the appellation 'silk' can only be applied to the natural product of the silkworm. This association and, incidentally, the British Rayon & Synthetic Fibres Federation, are most concerned to ensure that the term 'silk' be confined solely to the fibre produced by the silkworm. The use, therefore, of two such mutually exclusive terms is inimical to the interests of both the silk and synthetic fibres industries, as well as being most misleading to the public.

J. Hadley,

The Silk & Rayon Users' Association (Inc.)
London, W.1.

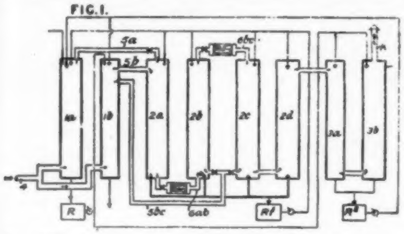
Chemical Engineering Invention

MONTHLY SUMMARY OF PATENT CLAIMS

Sulphuric acid process

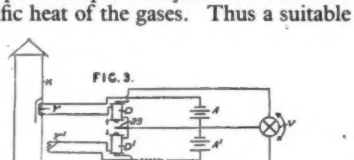
In a sulphuric acid manufacturing plant, employing nitrous vitriol as catalyst, of the kind comprising one or two denitrating towers (Glovers) and one or two recovery towers (Gay Lussacs) together with several intermediate production towers connected in series, the Glover or at least one of the Glovers, besides being connected, as regards the gaseous phase, to the first production tower, is also connected in parallel with one or more of the subsequent production towers, except the last one.

FIG. 1.



In Fig. 1, sulphur dioxide is fed from conduit 4 to Glovers 1*a*, 1*b*, and thence through pipes 5*a*, 5*b*, 5*bc*, to towers 2*a*, 2*b*, 2*c*, connected by pipes 6*ab*, 6*bc*. The gases from the last tower 2*d* pass into Gay Lussacs 3*a*, 3*b*, and exit through funnel *K*, while nitrous vitriol formed in the Gay Lussacs passes to tank R^{11} and is pumped into the Glovers; at the same time a part of the acid from the production towers and discharged into tank R^1 is pumped into Glover 1*a*, while the greater part of the acid is returned to the towers. The partly denitrated acid from Glover 1*a* is discharged into tank *R* from which a part is pumped to the Gay Lussacs, while another part is passed to Glover 1*b* for complete denitration. In another embodiment the towers are grouped together in a single parallelopipedal block. The process may be controlled automatically in connection with the composition of the funnel (*K*) gases, which may be determined by spectroscopic analysis or from the specific heat of the gases. Thus a suitable

FIG. 3.

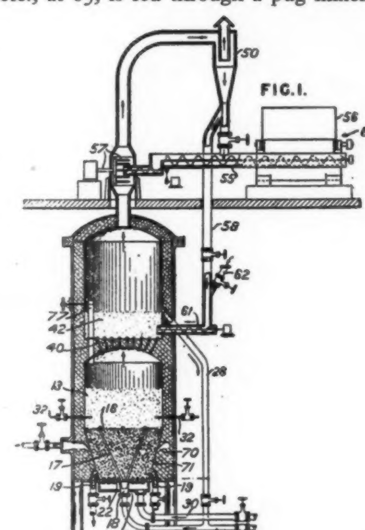


device (Fig. 3) comprises a resistance *r* immersed in the funnel gases and a standard resistance r^1, each being included in a separate circuit comprising a battery *A*, A^1, and a relay *D*, D^1. When the operation of the plant is satisfactory, armature 23 is disposed centrally, but a change in the composition of the gases, causing an increase or decrease in the conductivity of resistance *r*, results in the movement of armature 23 in the one or the other direction, thereby closing the appropriate circuit to cause a corresponding movement of valve *V*. In a modification, resistance r^1 and its circuit may be replaced by an adjustable spring acting on armature 23 in opposition to the attraction of the relay.—643,394, *P. Guareschi, G. Busseti, Maragliano and L. Pettenati.*

Calcining lime-bearing sludges

Lime-bearing sludges, *e.g.* from water-softening, paper mills and sugar factories are calcined by a fluidised technique in the presence of a material constituting an adhesive at the calcination temperature, whereby nodules of lime are produced. Suitable adhesives are alkali metal hydroxides, carbonates or other salts, ½ to 2% being employed. Sludges which already contain more than sufficient alkali metal compound must be treated for the removal of the excess. As shown, a sludge filter cake from filter 56, mixed with soda ash, etc., at 65, is fed through a pug mixer 55

FIG. 1.

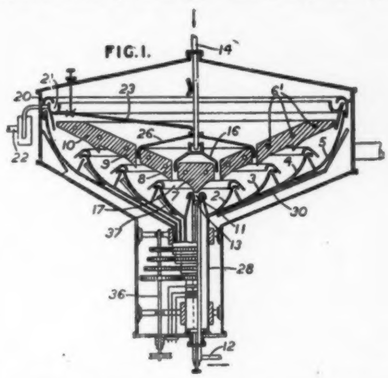


to a cage mill 57. The material dispersed therein is dried by the rising hot gases, and passes to cyclone 50. Part of the material from this cyclone passes to the pug mixer 55, and the balance through conduit 58 and conveyor 61 to bed 42. Here it is preheated to 1,000°F. and fluidised by gases passing through apertured partition 40 from the calcination zone 13. A variable amount of these gases is by-passed through pipe 77. Coarse limestone may be added through pipe 62. The preheated material passes down pipe 28 and is fed with fluidising air or gas from pipe 26 to a manifold 18. Thence it passes *via* four pipes 17, terminating in ball check plates 16, to the calcination zone 13. Here it is heated to 1,850°F. by oil or gas fed in from pipes 32. During calcination, because of the adhesive, the lime is formed into pellets which sink to a lower bed 71 where they are cooled. The air supplied through pipe 30, wind-box 24 and apertured ball check plate 22 is insufficient to cause fluidisation. The material discharges through pipes 19. Cooling air many be passed in through tuyeres 70, which are used initially to preheat the charge to 1,200 to 1,400°F. by hot combustion gases.—643,335, *Dorr Co.*

Short-path fractionating stills

A short-path fractionating still comprises several nested evaporating bowls concentrically arranged and mounted for

FIG. 1.

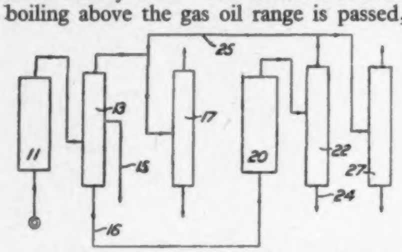


rotation about a central, vertical distillate receiver. Inclined annular condensing surfaces are arranged concentrically above the bowls with the lower edge of each surface projecting slightly over the next inner bowl. Annular baffles are mounted above the rims of the bowls, and an annular trough for distillation residue is associated with the outermost bowl. The distilland is thrown outwards by centrifugal action, and is guided from bowl to bowl by the baffles. The liquid evaporated from any bowl is condensed on its associated condensing surface, and the condensate drips from the edge of that surface into the next inner bowl or, in the case of the innermost condensing surface, into the central receiver. The still shown has four bowls 2, 3, 4, 5, associated with four condensing surfaces 7, 8, 9, 10, which have channels 6^1 for the circulation of cooling liquid. Two alternative arrangements for rotating the bowls are shown. The bowls shown in the left-hand half-section are separate and are arranged for rotation at different speeds by means of individual gear-wheels and shaft 36, while the bowls in the right-hand half-section are connected together and to a hollow shaft 28 for rotation at the same speeds. In the first arrangement each bowl is provided with an individual electric

heater 37, but in the second arrangement there is a single electric heater 30. The distilland is introduced into the still through pipe 14 and flows down conical surface 16 into bowl 2. Distilland thrown out of bowl 2 by centrifugal action is deflected by baffle 17 into bowl 3, while the vapours evolved in bowl 2 are condensed on surface 7 and the condensate drips into receiver 11. The function of the other bowls and condensing surfaces is similar. The residual distilland thrown out of bowl 5 is deflected by baffle 20 into trough 21 from which a proportion of it may be withdrawn through pipe 22. The remainder is recirculated into bowl 3 through pipe 23 and over conical surface 26. The distillate is withdrawn from the still through pipe 12, but by controlling valve 13 it may be caused to accumulate in the receiver and eventually spill over into bowl 2. Any desired degree of reflux may thus be obtained.—644,621, *G. Burrows and Metropolitan-Vickers Electrical Co. Ltd.*

Cracking heavy hydrocarbon oils

Hydrocarbon oils boiling above the gas oil range are cracked catalytically at a relatively high space velocity to give a high yield of gas oil which is withdrawn from the system. The cracked residue boiling above the gas oil range is passed,

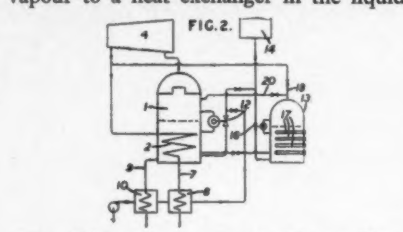


at a relatively low space velocity, through a second catalytic cracking stage where a high yield of good-quality gasoline is obtained. The gas oil separated after the first stage may be used as diesel fuel.

An Iranian wax distillate is cracked in the presence of steam, in reactor 11 which contains a synthetic silica-alumina catalyst at 900°F., the space velocity being 10.3 expressed as weight of oil/hr./unit weight of catalyst, and the reactor-outlet gauge pressure being 10 p.s.i. The products are passed to fractionator 13 where gasoline and higher hydrocarbons are withdrawn overhead, and gas oil of diesel index 20 is taken off through line 15. The residue boiling above the gas oil range is separated as bottoms through line 16, and passed (diluted with steam) at a space velocity of 0.81 through catalytic reactor 20 where the same temperature and pressure are maintained as in reactor 11. The products are passed to fractionator 22, from which gasoline and higher hydrocarbons are withdrawn overhead, and gas oil of diesel index 7 is withdrawn through line 24. The gasoline head fractions from fractionators 13 and 22 may either be stabilised separately in fractionators 17 and 27 to give gasoline with octane numbers 77 and 81, respectively, or the two fractions may be united *via* line 25 and stabilised in fractionator 17 to give a single product of octane number 79. Fluidised catalyst may be used in both reactors, the second reactor being operated with bottom catalyst draw-off, while the first is preferably operated by the upflow method in order to deal conveniently with the high linear velocities. —642,325, *Anglo-Iranian Oil Co. Ltd., and G. I. Jenkins.*

Evaporators of the vapour-compression type

An evaporator of the vapour-compression type is connected to an auxiliary evaporator which is heated by at least one electric immersion heater and supplies vapour to a heat exchanger in the liquid



space of the main evaporator. The auxiliary evaporator may be fed with distilled water, but, in the evaporation of a natural water containing only a small amount of solid matter, the raw water is supplied to the auxiliary evaporator and, after partial evaporation therein, is then introduced into the main evaporator. In this way, additional heat is supplied by an electric heater and the formation of scale thereon is reduced to a minimum. Vapour from the auxiliary evaporator may also be supplied to the vapour space of the main evaporator.

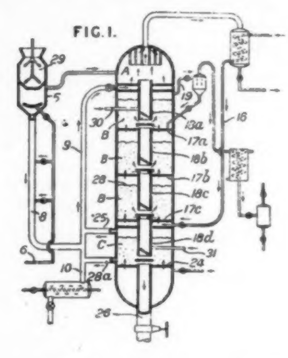
Raw water is pumped through heat exchangers 10, 8, and through control valve 12 into main evaporator 1. The top of evaporator 1 is connected with the suction side of compressor 4, which discharges compressed vapour into coil 2. Distillate leaves the evaporator through connection 7 and is cooled in heat exchanger 8. Blow-down is removed through connection 9 and is passed through heat exchanger 10. Auxiliary evaporator 13 contains electric heaters 17 and is supplied, through float-operated control valve 16, with distilled or fresh raw water from tank 14. The top of the auxiliary evaporator is connected by connections 18 and 20, respectively, to the discharge from compressor 4 and to the vapour space of the main evaporator 1.

In another embodiment, the connection 18 is led to an independent coil in the main evaporator. Provision may be made for varying the number of heating elements in use to suit the particular operating conditions. Distilled water withdrawn from the coil of the main evaporator may be supplied to the auxiliary evaporator.—642,845, *G. & J. Weir Ltd., H. Hillier and E. H. Patterson.*

Continuous production of carbon disulphide

Fluidised carbon is reacted with sulphur vapour, and the resulting carbon disulphide is separated and recovered. Excess of carbon over that required to react with the sulphur vapour is fed into the reaction zone and the excess of hot unreacted carbon is recirculated to the system, preferably in a fluidised condition, to supply its sensible heat thereto. As shown in Fig. 1, powdered coke is fed through a double bell valve 29 into a chamber 5 where it is fluidised by air admitted through a line 6. The fluidised coke passes through pipes 8 and 9 into zone *A* together with preheated air supplied through pipe 10. Partial combustion of the coke raises its temperature to 1,100 to 2,000°F. It then flows downwards through successive zones *B via* pipes 18*a*, 18*b* and 18*c*, in counter-current to preheated sulphur vapour entering by pipe 16 and passing through grids 17*c*, 17*b* and 17*a*.

The carbon disulphide vapour passes to recovery through pipe 19, whilst the excess of hot unreacted coke passes through pipe 18*d* into zone *C*. Here it is picked up by a stream of air fed beneath a grid 24 and recirculated in a fluidised condition through



lines 25 and 28*a* into pipe 10. An inert gas entering through line 30 removes air and carbon oxides from the coke passing from zone *A* to zone *B*. Similarly, inert gas entering through a line 31 removes sulphur vapours from the coke passing from zone *B* to zone *C*. A portion of the excess coke may be periodically purged through a pipe 26 to prevent accumulation of ash.

In a modification (not shown), the heating vessel and the reaction vessel (with a single zone) stand side by side. The hot fluidised carbon is continuously circulated by means of sulphur vapour from an intermediate level of the heating zone to the bottom of the reaction zone, and by means of air from an intermediate level of the reaction zone to the bottom of the heating zone. Fresh fluidised carbon is introduced into the heating zone and carbon disulphide vapours are removed from the top of the reaction zone. Specification 620,315 is referred to.—649,448, *Standard Oil Development Co.*

World News

GREAT BRITAIN

£450,000-p.a. company to promote fuel efficiency

The committee set up under the chairmanship of Sir Harry Pilkington to work out a scheme for increased fuel efficiency advisory services in industry recommended that an independent non-profit-making company should be formed to develop such services.

In a written Parliamentary reply, the Minister of Fuel and Power, Mr. Lloyd, states that the Government accept in principle all these recommendations and that the British Productivity Council has accepted the responsibility for forming and sponsoring a fuel efficiency company on the lines recommended in the report. The company, when set up, can expect an income of £450,000, thanks to the promise of annual contributions of £250,000 from the National Coal Board, £100,000 from the British Electricity Authority and £100,000 from the Gas Council. These contributions, which will be guaranteed for an initial period of five years, will be supplemented by fees charged for certain services and, it is hoped, by voluntary contributions from individual industrial concerns.

The Ministry's industrial advisory services will cease to function as the new company establishes its own.

Another contribution to fuel efficiency announced by the Minister is a survey of the potentialities of generating power by passing steam through engines or turbines before using it for heating. About 3,000 firms are taking part in the survey.

Brotherton buy chemical firm

The issued share capital of the Stockport United Chemical Co. Ltd., Buxton Road, Stockport, Cheshire, has been acquired by Brotherton & Co. Ltd.

The Stockport Co. will continue to operate as hitherto and, for the time being, no change in its functions is contemplated. Mr. Bertram E. Johnson has resigned from the board and the present directors are Mr. W. F. Dunnett, Mr. R. J. Hannay and Dr. A. F. Kertess.

Change of name

Sir W. G. Armstrong Whitworth & Co. (Ironfounders) Ltd. have changed their name to relate it more closely with their activities. The new name is Armstrong Whitworth (Metal Industries) Ltd.

Monsanto appointment

Mr. J. M. Kershaw has been transferred to the Overseas Division of Monsanto Chemical Co., St. Louis, as its London development representative. He will be stationed in London and will be responsible to Dr. W. D. Scott, director of development of the Division.

Mr. W. E. Bryden.

New director of Scotts

Mr. W. E. Bryden, A.M.I.Chem.E., has been appointed a director of George Scott & Son (London) Ltd. and Ernest Scott & Co. Ltd.

He was trained at Imperial College, London, and in 1938 he joined the Scott companies in London. In 1940 he was transferred to the head office of Scott's at Leven, Fife, and since then he has specialised in the paper and pulp industry. In this connection he has just returned from a tour of India, Burma and Thailand.

Polythene-film factory started

Construction has started at Stevenage, Hertfordshire, of the headquarters and factory of British Visqueen Ltd., the company formed jointly by Imperial Chemical Industries and the Visking Corporation of Chicago, U.S., to manufacture polythene film in Britain. Authorised capital of British Visqueen Ltd. is £240,000 in £1 shares. Two-thirds will be held by I.C.I. and one-third by Visking.

The chairman of British Visqueen Ltd. will be Mr. J. C. Swallow (who is chairman of the Plastics Division of I.C.I.) and the managing director will be Mr. N. J. Travis (who is at present on the staff of I.C.I. Plastics Division); other directors are Mr. A. F. Gawler, Mr. H. C. Raine and Dr. J. E. Sisson (all of I.C.I. Plastics Division) and Mr. F. C. Howard and Mr. A. T. Peterson (for the Visking Corporation). Polythene was discovered in I.C.I. laboratories in 1933 and I.C.I. has pioneered its manufacture in film form in Great Britain.

Polythene film is transparent, tough, inert, moisture- and water-proof and is used for packaging many commodities including foodstuffs, pharmaceuticals, chemicals, electrical and metal components, textiles, machinery and so on.

The Visking Corporation was formed in 1925 to manufacture seamless transparent tubes from regenerated cellulose. During the war, at the request of the U.S. Government, the corporation developed a process for manufacturing unsupported packaging film from polythene. Today, Visking are the world's largest producers of polythene film.

New 'Terylene' plant to be doubled

I.C.I. have decided to double the size of the *Terylene* fibre plant now being built at Wilton, Yorkshire. The original plant, with a scheduled capacity of 11 million lb. p.a. of filament yarn and staple fibre, is due to commence operation early in 1955 and the new extension will be ready a year later. This will be possible, because when the original plant was designed, plans were made for rapid extension should this be required.

For the past three years the supplies of *Terylene* have been limited to the output of the pilot plant near Fleetwood. This output has been used for evaluation and testing of a great range of potential uses for *Terylene*. The results of this work have more than borne out I.C.I.'s original confidence in this fibre and the decision to increase the size of the *Terylene* plant to a capacity of more than 20 million lb. p.a. has been made in order that the big demand for the fibre may be satisfied.

Water engineers see new works

At their summer meeting on July 3, the members of the South-East Section of the Institution of Water Engineers inspected the new works being constructed by the Colne Valley Water Co., Watford, Herts.

The works inspected were the Bricket Wood pumping station—one of three new pumping stations in the course of construction—the Hilfield Park reservoir and the Clay Lane treatment works.

The reservoir, which will have a capacity of 540 million gal., is the first large open reservoir to be constructed for storing raw water pumped from chalk wells.

The Clay Lane treatment works will be capable of purifying 24 million gal./day by the most modern methods. In addition to this work, the construction of a 25-million-gal. covered reservoir to hold treated water will be commenced in the near future. The new works will together cost £2,750,000.

When the Colne Valley Co. came into existence some 80 years ago the population served was under 9,000. The population now served exceeds 550,000 and requires a daily average supply of 23 million gal. The highest quantity of water supplied by the company in 24 hr. was 30 million gal. on June 30, 1952.

Royal Fellow for Institute of Welding

The Duke of Edinburgh has accepted Honorary Fellowship of the Institute of Welding. He was formally elected by the Council of the Institute at its meeting on June 10.

Anti-pollution measures of British Celanese

The anti-pollution measures so far undertaken by British Celanese Ltd., following the order made against them in the pollution action last year, were described by the chairman of the company, Mr. G. H. Whigham, in his annual address recently. He said that cooling units were being built which, when they came into operation early next year, should remove the complaint of overheating the river. The trade waste pollution figure of the company had been reduced by about 35%. However, it was improbable that the two years' grace given to the company would be enough to find a complete remedy for the problem, which, it was thought, would be best dealt with by treating the waste in combination with domestic sewage. Because of these difficulties, application for a further suspension of the injunction would be made next April.

Discussing production and plant expansion, the chairman said that progress had slowed down during the recent textile recess, but now things had improved and more money was being spent on modernisation, etc.

The net profit of the Group of £1,841,346 (before tax) for nine months was broadly equivalent to the rate of the previous year.

Anti-corrosion service

A new service intended to overcome to a certain measure the high cost of anti-corrosion construction work has been introduced by Corrosion Proof Products Ltd. The company is manufacturing a range of chemical-resistant products and is also providing a service that will enable the user's own maintenance staff or general contractor to carry out anti-corrosion constructional work. Some makers of anti-corrosion products insist on the necessary constructional work being undertaken by their own craftsmen.

The company makes a range of acid-, alkali-, oil- and solvent-resistant cements including silica cements, PF, cashew nut and furane resin cements, latex cements (both natural and synthetic), plasticised sulphur and bituminous compounds.

Corrosion Proof Products Ltd. was only recently formed. It has a nominal capital of £1,000 and is a subsidiary of Albert Moore (Pty.) Ltd., of Cape Town, the stainless-steel fabricators. The company's works are at High Wycombe.

Shell's new chemical plants

The growing interest of the Shell Petroleum Group in the chemical industry is illustrated in the company's report for 1952 which appeared last month. During the year, plants for producing acetone and other solvents from refinery gases were constructed at Montreal, Canada, and at Pernis, Holland, while at Stanlow (U.K.) the solvent plant capacity was increased. At Berre-l'Etang, part of the new plant to produce organic solvents from petroleum gases began operations towards the end of 1952. This plant is owned jointly with a French partner.

The production of *Teepol* detergent continued at Stanlow, Pernis and Petit-Couronne, France. The French plant is the latest to come on stream and production increased considerably during 1952.

Work on the new ammonia plant at Ventura, California, made good progress. When completed, it will form a substantial addition to existing capacity for fertiliser production. Methods originally developed by Shell for applying nitrogenous fertiliser to the soil, known as 'nitrojection' and 'nitrogation,' became increasingly popular in the U.S. The production of nitrogenous fertiliser by a Group company in the Netherlands continued at full capacity.

Manufacture of sulphur from natural gas was started at Jumping Pound in Alberta (Canada). In other areas, three new plans for the recovery of sulphur from refinery gases came into operation. One of these, at Stanlow, was the first plant in the U.K. for producing sulphur from petroleum. In addition, construction of a plant to produce sulphuric acid from either acid sludge or sulphur was taken in hand at this refinery.

Sulphur-recovery capacity at Pernis was further raised and the building of a sulphuric acid plant was started. Moreover, sulphur compounds occurring in refinery gases were sold to an adjacent chemical plant. A sulphur-recovery plant was also being built at Berre-l'Etang in France.

The Group is also increasing its production of insecticides and other crop-protection products. In the U.S., Shell Chemical Corporation have acquired a concern producing important insecticides which have been very successful in combatting locusts.

In addition, the Group has substantially increased production of *Epon* synthetic resins at its Houston, Texas, plant. The first plant outside the U.S. for producing these resins is nearing completion at Pernis.

New metals factory

Lord Colgrain, chairman of the Telegraph Construction & Maintenance Co. Ltd., recently laid the foundation stone of the company's new factory at the satellite town of Crawley, Sussex. The new factory, which will be devoted to the manufacture of Telcon metals (magnetic materials, electrical resistance alloys and special metals for the electronics industry and scientific instrument makers), will be completed in about a year and will be in full operation before the end of 1954. It involves the complete removal of the company's Metals Division from Telcon Works, Greenwich, and about 350 people will eventually be employed in the new factory.

Giant pressure vessel

A Babcock & Wilcox pressure vessel made for the Vacuum Oil Co.'s Coryton refinery has the largest diameter of any ever built at Oldbury works. Fabricated to the order of the Lummus Co. Ltd., the vessel has inside diameter of 13 ft. and an overall length of 56½ ft., of which some 37 ft. is in *Colclad* alloy clad plate, weighs 40½ tons and is designed to operate at 950°F. with a pressure of 25 p.s.i.

It will form part of some 800 tons of Babcock equipment ordered for Coryton, which aggregates 98 pressure vessels and 38 vertical columns.

Tin research progress

The annual report of the Tin Research Institute for 1952 states that the various groups of tin producers who provide the funds have unanimously agreed to increase their contributions by 50% in order to strengthen the Institute's staff and especially to increase its free technical services to industry in the chief tin-consuming countries of the world. The tin-producing countries supporting the Institute are the Belgian Congo, Bolivia, Indo-China, Indonesia, Malaya and Nigeria. Following this additional grant, information centres were opened in Canada, France, Italy and Sweden; centres already existed in Belgium, Holland and the United States. The Institute's H.Q. and laboratories have been at Greenford, Middlesex, England, since 1938.

A number of applications of tin which originated from research at the Institute are mentioned. The decorative tin-nickel electroplate has had difficulties during its first two years, but a suitable filtering medium has now been found. Tin-zinc electroplate, a corrosion-resistant coating, has found many further uses in the radio, motor-car and aircraft industries. There is work going forward on improved aluminium-tin-bearing alloys; their extra hardness as compared with tin-base babbitt alloys will, it is expected, enable these alloys to recapture for tin some of the market now held by copper-lead and other high-duty bearings.

Research on tinplate has been concerned largely with the quality of the tin coating on both the hot-dipped and electrolytic types. A satisfactory economical method of producing electrolytic tinplate in the laboratory has been installed and this permits close study of each of the various stages of manufacture.

EUROPE

O.E.E.C. Productivity Agency

A Director for the European Productivity Agency has been appointed by the Council of the Organisation for European Economic Co-operation. He is Dr. Karl Peter Harten, 52-year-old German productivity expert.

The European Productivity Agency came into existence, within the framework of O.E.E.C., on May 1, 1953. It was then stated that its main purpose would be 'to seek, develop and promote the most suitable and effective methods for increasing productivity in individual enterprises, in the various sectors of economic activity in the member countries, and over the whole field of their economies.'

Discovery that revolutionised the nickel industry

An historic moment in chemistry is portrayed in a model which has been made for the Mond Nickel Co. Ltd., part of which is shown in this photograph. As can be seen, it depicts a laboratory. In fact, it is the laboratory which Ludwig Mond had in the grounds of his house in Victorian Hampstead, London. There, one evening in 1888, Mond and an assistant accidentally discovered nickel carbonyl and thus the basis of the Mond carbonyl process for purifying nickel which is still used today.

The discovery arose from a series of experiments to discover why a carbon coating had developed on some nickel valves used in a plant for volatising ammonium chloride at Mond's chemical works. Earlier investigations had suggested that carbon monoxide was responsible, and the effect of finely divided nickel at about 350°C. in bringing about the decomposition of CO into CO_2 and free carbon was being studied. In the apparatus on the bench, carbon monoxide was passed slowly over finely divided nickel within the tube and, except when sampling for analysis, the deadly gas was allowed to burn at the exit end of the tube.

At the end of the day's experiments, one of Mond's collaborators had turned off the furnace burners prior to shutting down the apparatus. When the tube had cooled to about 100°C. the characteristic blue flame of carbon monoxide was seen to change to yellow. As the temperature fell lower the flame became very luminous and, when the glass tube at the exit end was heated, a metal mirror formed on it. This mirror proved to be nickel.

When told of the unexpected turn the experiment had taken, Ludwig Mond came over to see for himself. This is the moment portrayed in the model.

Examination showed that the gas containing the volatilised nickel was nickel carbonyl. Further experiments were made in an attempt to obtain similar compounds of iron and cobalt, but while iron carbonyl was obtained in minute amounts, no trace of cobalt carbonyl could be detected. Some years later Mond did succeed in isolating carbonyls of cobalt, ruthenium and molybdenum, but the readiness of nickel to form a volatile carbonyl and his initial failure to obtain cobalt carbonyl showed Mond the way to a new process for producing pure nickel from the nickel-cobalt-copper-containing ores. Thus the discovery of nickel carbonyl led him into the nickel refining business with momentous consequences, both personal and national.

The model has been made for Mond Nickel by Mr. Broun-Morison and it is fascinatingly detailed. Mond is shown with a cigar in his right hand and in his left a few pellets of pure nickel, the first to be made by the new process. Mond's house and laboratory in Avenue Road, Hampstead, have now gone and a block of flats stands there instead. So, advice on the appearance and furnishing of the laboratory was obtained from an old employee of Mond's who actually worked in it, although not at the time of the discovery of nickel carbonyl.

Chemical engineering federation

The European Federation of Chemical Engineering was formally inaugurated at a foundation meeting held in the Maison de la Chimie in Paris on June 20. Its purpose is to promote European co-operation in the fields of chemical engineering and equipment. The federation owes its origin to efforts commenced in 1951, and which assumed a more concrete form during the course of the European Convention for Chemical Engineering in 1952.

Fifteen scientific and technical societies were represented at the inauguration of the federation, and many more societies, some of which are located in Norway, Denmark, Luxemburg and Austria, have signified their early intention of joining the federation. The Institution of Chemical Engineers is not at present a member.

The activities of the federation are managed by a committee, of which the following were elected members: Herbert Bretschneider, Germany; Hans C. Egloff, Switzerland; Francis A. Freeth, Great Britain; and Jean Gérard, France.

The General Secretariats of the European Federation of Chemical Engineering are located in the Maison de la Chimie, 28 Rue Saint-Dominique, Paris.

ITALY

Superphosphate plant for Sicily

A large, new fertiliser factory is under construction at Porto Empedecle, Sicily, for the Societa Akragas of the Montecatini Group. The plant has been designed for the annual production of 50,000 tons of superphosphate with a high soluble phosphate content, or 30,000 tons of triple superphosphate. The plant will include a section for the production of 100 tons/day of oleum.

Output is expected to cover Sicily's requirements and to leave a surplus for export to Egypt and the Middle Eastern countries.

SWEDEN

Superphosphate makers meet in Stockholm

The International Superphosphate Manufacturers' Association held its annual series of meetings in Stockholm recently, at which some 280 delegates were present from 20 different countries, including representatives of the industry from New Zealand, India and the U.S.A.

Delegates were entertained at a cocktail party in the Technical Museum of Stockholm and a banquet in Stockholm Town Hall by the Swedish superphosphate manufacturers, who were also the hosts at an opera and ballet performance in the theatre of the palace of Drottningholm.

Visits were paid to the superphosphate works of A.B. Förenade Superfosfatfabriker at Norrköping and to those of Gäddvikens Superfosfatfabriks A.B. in Stockholm.

Mr. R. Standaert (Belgium), president of the Association since 1949, did not offer himself for re-election, for health reasons, and Mr. D. J. Bird (United Kingdom) was elected in his place. At the general meeting, a warm tribute was paid to Mr. Standaert for his outstanding services to the Association during his years of office and he was unanimously elected honorary president.

Mr. A. Bloombergen (Holland), vice-president of the Association, on his retirement from business resigned this office, and sincere thanks were tendered to him at the general meeting, as also to Mr. Stevenius-Nielsen (Denmark) retiring vice-president and chairman of the Raw Materials Committee for several years, for their considerable services.

For the year 1953-54, the following officers were elected or re-elected:

President: Mr. D. J. Bird (United Kingdom). *Vice-Presidents:* Messrs. H. Bährer (Switzerland), J. Capelo Portabella (Spain), B. Colbjörnsen (Sweden), R. Grandgeorge (France) and J. D. Waller (Holland).

Dr. G. F. New was appointed secretary for the year 1953-54.

The date and venue of the 1954 series of annual meetings has not yet been fixed.

A series of technical meetings of members will be held at Cambridge in September next, at the invitation of the U.K. members.

NORWAY

Aluminium company's good year

Norway's biggest aluminium plant, Årdal & Sunndal Verk, made a gross profit of £1,551,000 last year. After deducting taxes and pension premiums, the entire surplus has been used to write off capital assets. Production at Årdal, W. Norway, last year was 25,000 tons of raw aluminium and 30,000 tons of pig iron. Of the aluminium, 8,280 tons went to the Aluminium Union Ltd. of Canada in payment for oxide supplied by that company.

GERMANY

U.S. aid for aluminium plant

The U.S. Government has loaned 10 million marks to the Vereinigte Aluminium Werke A.G., Bonn, for the reconstruction of its aluminium smelting plant at Grevenbroich. Total reconstruction costs of the plant are estimated at about 40 million marks.

The loan was made under the Mutual Security Agency's Basic Materials Programme, which is intended to reduce the drain on U.S. resources and assure the production of adequate supplies of materials for Western defence.

The Grevenbroich plant is expected to have an annual production capacity of 15,000 tons of primary aluminium. Reconstruction is expected to be completed by the end of this year, with the plant reaching full production in 1954.

The two other smelting plants of the Vereinigte Aluminium Werke, at Toeging and Luenen, have already been rebuilt with the aid of U.S. funds. Under the terms of the loan the U.S. Government has an option on aluminium produced by the Vereinigte Aluminium Werke.

Achema XI

The Achema XI Chemical Engineering and Equipment Exhibition will be held in Frankfurt-am-Main from May 14 to 22, 1955. The Achema X was held last year.

I.G. successor's big plans

Farbwerke Hoechst A.G., one of the largest successor companies of the former I.G. Farbenindustrie, intends to spend most of this year's investments on expanding its installations for the production of *Perlon* synthetic fibre at its Bobingen subsidiary.

Last year's investments amounted to 92 million marks, which were mainly used for rebuilding, modernisation and extension of the Hoechst plant and for the building of a new phosphorus plant at the Knapsack Griesheim subsidiary. The spokesman did not disclose the total amount of investments to be made this year.

The company has issued a report on its activities, production and business development in 1952 and in the first half of 1953. The firm was set up as an independent successor company last March. A normal balance sheet and a company report were being prepared and were expected to be completed later this year. The conversion of I.G. Farben shares into new shares of the successor company might be expected to begin in autumn this year, possibly in September.

The firm plans to increase output of existing lines or add new products in practically all sections. This applies to the production of antibiotics (penicillin and streptomycin), phosphates, fertilisers, dyestuffs and fire-extinguishing materials.

New benzole refinery

A new plant for the refining of benzole under pressure has been opened by the Harpener Bergbau A.G., Dusseldorf.

The processing capacity of the plant is between 5,000 and 6,000 tons/month. The method of production used, developed by the Scholven Chemie A.G., is said to avoid heavy losses during the refining process and yield benzole of a very high purity.

HUNGARY

PVC products

PVC plastics are now being used in Hungary for a wide range of industrial products. At a factory in Nagytétény, water pipes are being produced by extrusion moulding. Plastic sheeting is also manufactured. Plastics are being used for tooth-paste and other tubes, and the production of shoe soles and machine belting is said to be projected.

Moulding powder is at present being imported from Eastern Germany. Plans are afoot to manufacture it in Hungary, where existing supplies of coal, petroleum and natural gas provide ample raw materials.

EGYPT

Plans for rapid increase in fertiliser production

Egypt has facilities for expanding production of calcium nitrate to 250,000 tons. Production in 1951 was 140,000 metric tons.

As part of the electrification project at Aswan Dam, it has been proposed to build by 1957 an ammonium-nitrate plant with an annual capacity of 370,000 tons of nitrogenous fertilisers, which would greatly reduce the country's dependence upon imports of these materials.

Nitrogen requirements have increased because of the extension of periodic irrigation. They were estimated at 101,000 tons in the 1950-51 season.

Average annual imports in the pre-war period amounted to 78,500 tons, compared with estimated requirements of 90,700 tons. During the war years, 1942-46, annual imports dropped about 50% to 34,500 tons, but increased to 90,300 in the period 1947-51, or 14% above pre-war.

Although Egypt has been an importer of superphosphate for many years, the country produces a surplus of phosphate rock. Large-scale production of superphosphate began in 1948 and capacity is now almost sufficient to meet estimated needs of 95,000 tons.

Paper mill to be built

The Egyptian Government has approved a plan for the setting up of a paper mill using Egyptian raw materials, such as rice straw, cotton-plant stems and sugar-cane wastes. Planned output of the mill is initially 20,000 tons annually of letter and printing paper and 10,000 tons of newsprint.

The project is to be carried out by an Egyptian company to be formed with Government approval. Capital will be provided by the promotors approved by the Government. At present the Government is asking interested parties to submit details of their method of putting the project into operation.

INDIA

Superphosphate plant for Sindri

The Government of Bihar State is planning to set up a superphosphate plant near the Sindri ammonium sulphate factory. Erection costs are put at about 7 million rupees and the plant is scheduled to have a productive capacity of some 240 tons/day. It would go into production in 1954.

JAPAN

Fertiliser export plan

A plan for organising a special joint company for handling exclusively exports of ammonium sulphate from Japan has been revived by the Japanese fertiliser industry, according to the Japan Ammonium Sulphate Manufacturers' Association. The plan was originally taken up for discussion in the latter half of last year, as a measure to tide over a slump in exports of ammonium sulphate, but was later replaced by an informal price agreement among leading fertiliser companies. The price agreement, however, was not popular with the Fair Trade Commission, guardian of the occupation-sponsored Anti-Trust and Cartel Law.

A recent meeting of the Advisory Commission on Fertiliser has approved a new proposal advanced by its chairman, Dr. Seiichi Tohata, for fixing official ceiling and floor prices for domestic deliveries of ammonium sulphate and for setting up a special company for handling ammonium sulphate exports.

Under the plan proposed by Dr. Tohata, the projected company would buy ammonium sulphate intended for export from the manufacturers at the official floor price. These stocks could be resold to the same manufacturers only for export purposes, but the Government would subsidise the losses the manufacturers might incur by exporting these stocks. The Association added, however, that many difficult problems would have to be resolved before the project could be finally adopted by the Japanese fertiliser industry. For instance, it is not known yet how much the proposed subsidies would amount to annually, while the whole idea of a joint company might again invite opposition from the Fair Trade Commission.

CEYLON

Salt exports planned

Ceylon's record salt production this year will enable her, for the first time, to export 20,000 tons, it is reliably stated in Colombo. The island's increased output was credited to improved methods suggested by United Nations' experts attached to the Salt Department there.

Japan is expected to buy most of the surplus, and official circles believe she could become Ceylon's chief salt buyer, as Ceylon is nearer Japan than present suppliers in Europe and the Middle East.

PAKISTAN

Khewra Soda Co.

Imperial Chemical Industries announce that an offer to nationals of Pakistan of 227,044 shares of 10 Pakistan rupees each at par in the Khewra Soda Co. has been 'heavily' oversubscribed.

The offer followed the acquisition by I.C.I. from the Alkali & Chemical Corporation of India Ltd. (in which company I.C.I. owns indirectly 70.7% of the equity) of the soda ash factory at Khewra, Pakistan. The whole of the assets were transferred on June 1 to the Khewra Soda Co., a public company formed in Pakistan, and I.C.I. were allotted the whole of the shares of the soda company in satisfaction of the purchase consideration of the assets of the business.

The offer, which represents 30% of I.C.I.'s holding in the soda company, was made in accordance with an undertaking to the Pakistan Government.

CANADA

Novel pulp process

Scientists of the Pulp and Paper Research Institute of Canada have invented a new process claimed to cut chemical pulp manufacturing costs and increase output per cord of wood with no reduction in quality.

Called the *Va-Purge* system, it is said to increase pulp yield through greater uniformity and reduction of rejects, to give a much shorter pulp-cooking time when 'vapour phase' cooking is used and a somewhat shorter cooking time with 'liquid phase.' It is also claimed that the new process makes it possible to use mixtures of species with little effect from variations in moisture content owing to seasoning.

Higher sulphur output

Expanding production of sulphur in various forms in Canada will be able, by 1955, to supply 60% of Canadian consumption despite an expected increase in demand of 20% during the next two years. This is concluded in a recent bulletin of the Department of Defence Production.

The survey shows the total Canadian production of sulphur in all forms is expected to rise to nearly 570,000 long tons this year, 610,000 tons next year and 628,000 in 1955. This will be close to the level of estimated total Canadian consumption—629,000 tons this year, 648,000 tons next year and 664,000 tons in 1955.

However, exports have in the past absorbed up to 80% of Canadian output in the form of sulphur ores, because of lack of extraction facilities.

This year, Canadian processing and use of sulphur from pyrites is expected to rise from 30,000 tons in 1952 to nearly 80,000 tons and up to 152,000 tons by 1955.

Altogether the production of sulphur to meet Canadian needs is anticipated to rise from around 200,000 tons last year to nearly 384,000 tons by 1955, with a parallel decline in imports.

> **The Leonard Hill Technical Group—August**
>
> **Manufacturing Chemist**—Antibiotic Research in Somerset; Canadian Chemical Expansion; Progress in Vitamin Science; Comparative Activity of Phenyl Mercury Compounds; Progress Reports on Economic Poisons and Detergents.
>
> **Food Manufacture**—Western Margarine Ltd. factory article; Pressure Cooking and Cooling, 2; Food Group Tour; Australia's Canned Fish Industry.
>
> **Fibres**—Carding in the Wool Mill; Seaweed and the Textile Industry, 2; Fibres for Pulp and Paper Manufacture.
>
> **Paint Manufacture**—Practical Experience with Emulsion Paints; Freeze, Thaw Problems with Latex Emulsions; Evaluation of Latex Paints; Research on the Oxidation of Fatty Acids and Esters; History of Paints and Varnishes in Great Britain, 2.
>
> **Petroleum**—Rumanian Oil Industry; Training Engineers for the Petroleum Industry.
>
> **Atomics**—The Effect of Pile Radiation on 'Perspex'; The French Atomic Energy Project; Report on the D.S.I.R., 1951-52; Atomics in Industry, 2.
>
> **Building Digest**—Post-war Building Progress in Germany; New Building Methods in the U.S.S.R.
>
> **Muck Shifter**—The Reconstruction of the North Docks of the Port of Liverpool; Construction Work for the New Puerto Rico International Airport.

First plant to make phenol and acetone from cumene

The Montreal plant of B.A.-Shawinigan Ltd. for producing phenol and acetone from cumene has been opened. It will produce 13 million lb. of phenol, 8 million lb. of acetone and lesser amounts of cumene hydroperoxide, acetophenone, α-methylstyrene and mesityl oxide. Canada will now be self-sufficient in phenol and almost so in acetone. Phenol has not been manufactured in Canada in quantity before; acetone was formerly produced from acetylene. The plant, first of its kind in the world, will use the Hercules (U.S.)-Distillers (U.K.) process under licence. Cumene (isopropylbenzene) is oxidised by air to cumene hydroperoxide with the simultaneous yield of some dimethylbenzyl alcohol and acetophenone. The cumene hydroperoxide is then split and rearranged to phenol and acetone by an acidic catalyst, the dimethylbenzyl alcohol being dehydrated simultaneously to α-methylstyrene. Higher phenols and mesityl oxide also appear. The cumene required is obtained from the adjacent B.A. refinery, where it is produced from the propylene of cracking gases and the benzene of coal tar. Preliminary news about this new plant was given in CHEMICAL & PROCESS ENGINEERING, June 1952, p. 298.

B.A.-Shawinigan is owned equally by the British American Oil Co. and Shawinigan Chemicals Ltd.

Carbide project shelved

Shawinigan Chemicals Ltd. has decided that 'in view of changed conditions' not to proceed with the construction of a new carbide plant at Varennes, Quebec, as was announced last year.

Steel direct from molten iron

Dominion Foundries & Steel Ltd. (Dofasco) has bought the Canadian rights for a process of making steel direct from molten iron by the use of oxygen. The agreement was made with the Brassert Oxygen Technique A.G. of Zurich.

A special furnace is to be constructed by Dofasco for the process and it will be in operation early in 1954. The president of Dofasco said: 'So far as we know, we shall be pioneering this new process for both Canada and the U.S.'

New furnace-black plant

A $3-million oil furnace-black plant has been opened officially in Sarnia, Ontario. This is the first such operation in Canada's history. The plant, owned by Cabot Carbon of Canada Ltd., is expected to produce 25 million lb. of oil furnace blacks annually, particularly for use in the rubber industry. It will supply Canadian rubber manufacturers with a raw material which previously had to be imported from the U.S.

Cement plant to be started soon

Construction of the main section of the $12-million Swiss-owned St. Lawrence Cement Co.'s plant near Quebec City is scheduled to begin early in 1954. The plant is expected to come into production in the autumn of 1955 and to have an annual capacity of 1½ million barrels of Portland cement. Total 1952 cement output in Canada was about 18 million barrels.

The venture is understood to be backed by the Cement Works Holderbank A.G. of Switzerland.

Ammonia plant for Montreal

The Dominion Tar & Chemical Co. is reported to be planning the construction of an ammonia plant with an output of 150 tons/day at Montreal East. The plant would help overcome a growing shortage of this basic material for the fertiliser and other industries in eastern Canada.

UNITED STATES

Chemical engineering and atomics

The American Institute of Chemical Engineers are planning an international meeting, lasting a week, which will explore the chemical engineering aspects of nuclear processes. It is hoped that the meeting will take place at the University of Michigan from June 20 to 25 next year, and experts from all over the world have been invited to attend. The technical programme is being drawn up by Prof. D. L. Katz, who is head of the Chemical Engineering Department at the University of Michigan, and who was recently appointed head of the Nuclear Energy Committee of the American Institute of Chemical Engineers. The meeting will commence with a conference, lasting a day, which will study the educational problems associated with the training of engineers in the nuclear field. Other discussions to be held will include a two-day discussion on the design of nuclear power reactors, and also one on the social impact of the atomic age. Full technical discussions are also scheduled on fuel resources, fuel preparation, chemical processing of spent fuel, disposal of radio-active products, use of isotopes, safety, instrumentation and control.

Butadiene costlier under private enterprise ?

The sale of U.S. Government butadiene plants to private interests would contribute substantially to an increase in the price of the chemical, according to the general manager of the Chemical Products Department of the Esso Standard Oil Co.

He said that shortages of butadiene would also help to raise the Government fixed price of 15 cents/lb. The U.S. required 691,000 short tons of butadiene p.a. and the capacity of Government and private plants at present fell about 54,000 short tons below demand. ' If Government butadiene facilities are sold, it is doubtful whether private enterprise can make the product as cheaply as the Government, for the latter pays no taxes and has little or no sales, advertising or development expenses,' he said.

New plant for hydrocarbon oxidation

The Warren Petroleum Corporation is entering the petrochemical field and will build a plant at its gas terminal on the Houston ship canal. The plant is expected to be completed early in 1954. The decision to enter the new field, it is understood, follows improvements which have been developed at Warren's research laboratory in an oxidation process on which the company has held patents for some time. The hydrocarbon oxidation process will be used to convert either propane or butane, or their mixtures, into pentaerythritol, methyl alcohol, acetaldehyde and other petrochemicals.

Sulphur production

Final figures for United States production of sulphur by the Frasch process in 1952 show that production, 5,293,145 long tons, was slightly greater than in 1951. Figures for the individual major companies show that the Texas Gulf Sulphur Co. produced 2,957,557 tons, Freeport Sulphur Co. 1,691,995 tons, Jefferson Lake Sulphur Co. 405,383 long tons and the Duval Sulphur and Potash Co. 238,210 long tons. Production of recovered sulphur increased from 184,013 long tons in 1951 to 248,076 long tons in 1952. The increase resulted from the expansion programmes of companies processing sour natural gas.

Ammonia plant for Arizona

The National Distillers Products Corporation has announced plans to build a new plant for the manufacture of synthetic ammonia and nitrogenous fertilisers at Tuscola, Arizona. Total cost is put at $7 million and production is scheduled to start in January 1955. Production capacity would be 50,000 tons p.a. in terms of anhydrous ammonia. By-product oxygen output would amount to some 75 tons/day.

Government synthetic rubber plants to be sold

Following President Eisenhower's recommendation, reported in CHEMICAL & PROCESS ENGINEERING, June 1953, the chairman of the U.S. Senate Banking Committee has introduced legislation authorising the sale of the Government's synthetic rubber plants to private industry. The bill ' requires that the Government obtain the full fair value of each facility sold.'

Polythene expansion programme

United Carbide and Carbon Corporation has announced a large expansion programme for the production of polythene, first developed in the U.K.

The Bakelite Co., a division of Union Carbide, is to build three new plants in the natural gas fields of Texas and California, which, together with other facilities planned or under construction, will bring U.S. output of the material to over 500 million lb. by 1955. Bakelite would turn out about half this amount, it was stated.

Phenol made by new process

A new process developed by the Hercules Powder Co. of Wilmington, Delaware, for manufacturing phenol from air and oil, will be used at a new plant being opened shortly in Montreal, East Quebec.

The new plant is owned and will be operated by B. A. Shawinigan Ltd., under licence from Hercules. When ultimate production rates are reached, the plant will turn out about 13 million lb. p.a. of phenol and about 8 million lb. of acetone, in addition to by-products.

New chemical plant in Louisiana

The first completed unit of American Cyanamid Co.'s Fortier plant under construction in Jefferson Parish, Louisiana, is now producing sulphuric acid. Next to be completed will be the 100-ton-a-day ammonium sulphate facilities.

The plant, which is expected to be completed early next year, will produce from natural gas such nitrogen chemicals as ammonia, acetylene, hydrocyanic acid and derivatives of these, including acrylonitrile and ammonium sulphate.

Silicon made by new process

A process for manufacturing pure silicon for transistors, which may lead to more powerful and less bulky television, radio and other electronic and electric equipment, has been developed by the Du Pont Co. Silicon is attractive in the electronics field because of its ability to withstand higher temperatures and to handle more power than other semi-conductors. Germanium has been used in transistors, as was described in an article in CHEMICAL & PROCESS ENGINEERING, June 1953, but it is thought that pure silicon will compete with it in some uses. The pure silicon made by the new process is a brittle, grey substance of crystalline appearance. Its specific gravity is 2.4.